APPENDIX A: CMAQ ANALYSES

Emissions Reduction Analysis
for
El Paso County Transit

EPC Transit Study Scenarios 3 and 6

Regional Transit Start-up assistance
for FY 21-23

March 2020

By

Texas A&M Transportation Institute

Task Summary

The Texas A&M Transportation Institute (TTI) El Paso office was tasked by El Paso County Transit to perform a mobile source emissions analysis for two potential service expansion scenarios in the El Paso nonattainment area. The transit agency is seeking funding from the Congestion Mitigation/Air Quality Improvement Program (CMAQ).

The analysis focuses on the air quality benefits of two service expansion scenarios identified and supported from a feasibility study on transit service in El Paso County.

Individual Project Analysis

The emissions analysis for the project is presented below. The strategy name is given along with a brief description of the project. Data sources and analysis assumptions are provided. The equation used from the *Texas Guide to Accepted Mobile Source Emission Reduction Strategies* (MOSERs Guide) is given for the strategy along with the variables of the equation and the equation itself. The results are then computed for the strategy equation.

It is recommended that the agency conduct a more detailed emissions study of the project as it develops further. The results presented below are valid for CMAQ program submission, but this analysis should not be used for conformity purposes.

EPC Transit Study Scenarios 3 and 6

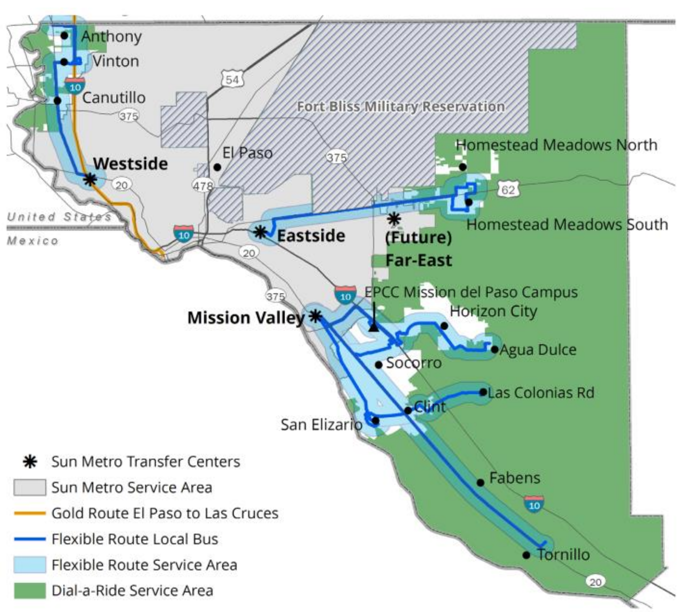
TTI was tasked by El Paso County Transit to conduct a feasibility study for potential service changes and expansion in its service area. The purpose of the study was to:

- Examine the feasibility of a seamless, countywide fixed-route transit system for all El Paso County
- Identify alternatives for transit within travel corridors throughout El Paso County
    - Service design
    - Organizational structure
    - Funding
- Assess potential to improve transit service for access to jobs, education, medical, shopping, personal business

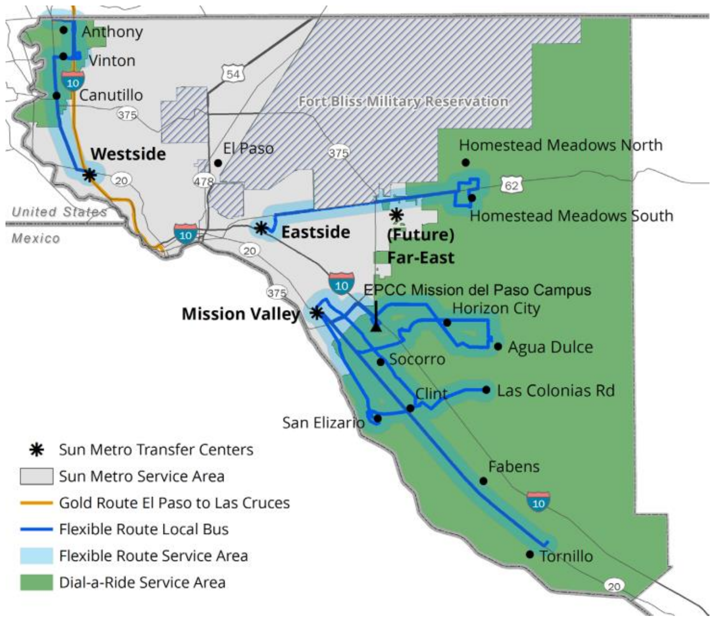
Stakeholders involved in the study chose two service expansion scenarios for further study, including the potential air quality benefits for the region. These are identified in the study as Scenario 3: Flexible-Route Local Bus and Rural Dial-a-Ride and Scenario 6: Increased Flexible-Route Local Bus and Rural/Urban Dial-a-Ride.

El Paso County Transit currently provides service on six county bus routes, the Gold Route intercity bus between Las Cruces, NM, and El Paso, TX, and the Vamonos Vanpool program. The six county bus routes operate along established routes with set schedules, and passengers can get on and off the bus by flagging the bus driver. The county bus routes link communities throughout El Paso County, and all routes connect to a Sun Metro transfer center.

Scenario 3: Flexible-Route Local Bus and Rural Dial-a-Ride provides service to almost all currently served areas. Some routes will have increased frequency and hours of service. All routes are designed to serve passengers traveling in either direction along the route and are scheduled to improve transfers between routes. Dial-a-ride serves rural areas outside the flexible-route service area. The Gold Route and Vamonos Vanpool program continue unchanged.



Scenario 6: Increased Flexible-Route Local Bus and Rural/Urban Dial-a-Ride provides service to almost all currently served areas. Some routes will have increased frequency and hours of service. All routes are designed to serve passengers traveling in either direction along the route and are scheduled to improve transfers between routes. Dial-a-Ride serves all areas of the county outside the flexible-route service area. The Gold Route and Vamonos Vanpool program continue unchanged.



Data Sources

The TTI team utilized several sources for the analysis: El Paso County *Transit Study Scenarios* section of the feasibility study that provided details of each scenario and current service, the El Paso County Transit Title VI Plan (April 2017), and internal route data.

The technical report *2017 On-Road Mobile Source Annual, Summer Weekday and Winter Workday Emissions Inventories: El Paso Area* (TTI, August 2019) describes development of 2017 analysis year El Paso MOVES2014-based actual on-road inventories, which were the basis for these MOVES runs, with respect to MOVES modeling procedures and MOVES input data. MOVES modeling set-ups and input data combinations are described starting on Page 33 of the report, in the section "Estimation of Summer and Winter Weekday Emissions Factors." Tables 22 through 33 and surrounding text contain the details. The MOVES modeling part of the process and the local/default input data combinations as described (Table 24) was used, updated where appropriate for model version and for analysis year. The MOVES inputs for this analysis are consistent with the El Paso County 2017 AERR inventories analysis, with updates as needed (e.g., expected future year values for fuel properties). VMT hourly factors are consistent with the El Paso 2017 AERR inventories analyses; the vehicle type VMT mix estimate was developed consistent with the methodology as described in the El Paso 2017 AERR report, but for 2025 analysis year.

Transit passenger characteristics were derived from the American Public Transportation Association report *A Profile of Public Transportation Passenger Demographics and Travel Characteristics Reported in On-Board Surveys* published in May 2007 and the passenger characteristics information in the agency's Title VI plan.

Analysis Methods

TTI staff used the analysis method provided in the August 2008 version of the MOSERs Guide, equation 3.1 - *System/Service Expansion*. The detailed equation is provided below in Strategy Equation.

Stated in words, the equation measures the reduction in start emissions and running exhaust emissions from a change in mode during the operating period and subtracting any additional emissions from the transit vehicles. The benefit is derived through attracting single occupant passenger vehicle drivers to utilize transit as their mode of travel.

The analysis year used is 2025. *For planning purposes, the emissions benefit of a static program will decline over time.*

Assumptions in the MOVES2014a output for the project included:

- Output created for VOC, CO, NOx, and PM-10
- Light-duty passenger vehicles and light-duty passenger trucks (SUVs) vehicle types, gasoline and diesel-fueled, and transit buses are included according to a projected regional VMT fleet mix (Source Type ID 21, 31)
- Transit vehicle (source type 43) emission rates were included. Sourcetypeid 43 is composed of four MOVES regclass IDs: 41, 42, 46, and 47. Regclassid 41 rates output were selected as most representative of the County Transit vehicle rates.
- Running exhaust, running evaporative, brake wear, tire wear, and start emissions (Process ID 1, 2, 9, 10, 11, 12, 13, 15, 16)
- Considering the project area and the type of trips reduced through the strategy, primarily, freeway commuting, emissions on Road Type 4, urban restricted access, was used for the passenger vehicles. Road Type 5, urban unrestricted access, was used for the transit vehicles.
- Passenger vehicle replaced average speed during operating hours (peak and off-peak) is assumed 30 mph (speed bin 7).
- Average transit vehicle speed is assumed 25 mph (speed bin 6) based on data received from Sun Metro.
- The analysis period is 6:00 a.m. to 8:00 p.m. on a winter weekday for CO; the same period on a summer weekday for NOx, VOC, and PM-10.
- The vehicle trips reduced (VT_R) and vehicle-miles travelled reduced (VMT_R) were distributed proportionally across the 14 hours of model analysis and by vehicle type and fuel type in line with the vehicle fleet mix in the El Paso region.

TTI staff reviewed the project information to determine values for the individual variables in the MOSERs equation. The MOSERS Guide encourages planners to make conservative, justifiable assumptions about projects.

- Based on the available ridership data, factoring in 25% of the increased ridership will be previous riders, an average new, former single occupant vehicle daily ridership of 1,097 for Scenario 3 and 2,997 for Scenario 6 was assumed.
- Scenario 3 shows 20.5 additional hours of service; Scenario 6 shows 56 additional hours.
- Additional bus mileage for Scenario 3, based on acquisition of 3 new transit vehicles, is 193 miles per day; additional bus mileage for Scenario 6, based on acquisition of 6 new transit vehicles, is 1,025 miles per day
- An average trip length replaced of 18 miles was assumed based agency route maps. The trip lengths were distributed evenly in the reduced VMT.

The final estimated emission reductions are presented in kilograms per day (kg/day) in accordance to CMAQ project reporting requirements.

Strategy Equation

Note: Due to the extensiveness of the MOVES model output data and to help presentation of results, the individual start rates and emission rates per distance ($\mathbf{TEF}_{AUTO}$ and $\mathbf{EF}_{B}$) per vehicle type computed are not presented but are available for review, if needed.

3.1 System/Service Expansion

Daily Emission Reduction (for each pollutant) = A + B – C – D

$$A = VT_R * TEF_{AUTO}$$

Reduction in auto start emissions from trips reduced

$$B = VMT_R * EF_B$$

Reduction in auto running exhaust emissions from VMT reductions

$$C = VT_{BUS} * TEF_{BUS}$$

Increase in emissions from additional bus starts

$$D = VMT_{BUS} * EF_{BUS}$$

Increase in emissions from additional bus running exhaust emissions

Where

$$VT_R = N_{TR} * F_{T, SOV}$$

Number of new transit riders multiplied by the percentage of riders shifting from single-occupant auto use

$VMT_R = VT_R * TL_W$

Number of vehicle trips reduced multiplied by the average auto trip length

Final unit of measure: grams/day
Source: Texas A&M Transportation Institute

Variables:	$\mathbf{EF_{B}}$:	Speed-based running exhaust emission factor for affected roadway before implementation (NO_x, VOC, or CO) (grams/mile)
	$\mathbf{EF_{BUS}}$:	Speed-based running exhaust emission factor for transit vehicle (NO_x, VOC, or CO) (grams/mile)
	$\mathbf{F_{T, SOV}}$:	Percentage of people using a transit vehicle that previously were vehicle drivers (decimal)
	$\mathbf{N_{TR}}$:	New transit ridership
	$\mathbf{TEF_{AUTO}}$:	Auto trip-end emission factor (NO_x, VOC, or CO) (grams/trip)
	$\mathbf{TEF_{BUS}}$:	Bus (or other transit vehicle) trip-end emission factor (NO_x, VOC, or CO) (grams/trip)
	$\mathbf{TL_{W}}$:	Average auto trip length (miles)
	$\mathbf{VMT_{BUS}}$:	VMT by transit vehicle
	$\mathbf{VMT_{R}}$:	Reduction in daily automobile VMT
	$\mathbf{VT_{BUS}}$:	Daily vehicle trips by transit vehicle
	$\mathbf{VT_{R}}$:	Reduction in number of daily automobile vehicle trips

Analysis

For presentation purposes, the MOVES calculation results and extensive results from the equation calculations are not presented in the results below.

<u>Scenario 3</u>

$VT_R = (1{,}464 * 2) * 0.75 = 2{,}196$ trips/day

Number of transit riders multiplied by 2 multiplied by the percentage of riders shifting from single-occupant auto use

VMT_R = 2,196 * 18 = 39,528 vehicle-miles/day

Number of vehicle trips reduced multiplied by the average auto trip length

<u>Scenario 6</u>

VT_R = (3,996 * 2) * 0.75 = 5,994 trips/day

Number of transit riders multiplied by 2 multiplied by the percentage of riders shifting from single-occupant auto use

VMT_R = 5,994 * 18 = 107,892 vehicle-miles/day

Number of vehicle trips reduced multiplied by the average auto trip length

Summary of Results

The emissions analysis results for the scenarios is shown in Table 1. There are significant emissions benefits for all four pollutants. The results indicate an estimated air quality benefit from both scenarios if implemented.

Table 1. EPC Transit Study Scenarios 3 and 6 Emission Reductions

Pollutant	Scenario 3 Reductions (kg/day)	Scenario 6 Reductions (kg/day)
CO	44.015	103.979
NOx	2.182	4.733
VOC	2.784	6.162
PM_{10}	1.041	2.300

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Emission Reduction Analysis for City of El Paso Proposed CMAQ Project

Traffic Management Center Upgrade Phase 2 – Design and Construction

March 2020

Prepared for

By

Task Summary

The Texas A&M Transportation Institute (TTI) was tasked by the City of El Paso to perform a mobile source emissions analysis for a proposed project in the El Paso metropolitan region. The city is seeking funding from the Congestion Mitigation/Air Quality Improvement Program (CMAQ) to begin the phased implementation of improvements to the City's Traffic Management Center.

Individual Project Analysis

The emissions analysis for the project is presented below. The project name is given along with a brief description of the project. Data sources and analysis assumptions are provided. The equation used from the *Texas Guide to Accepted Mobile Source Emission Reduction Strategies* (MOSERs Guide) is given for the strategy along with the variables of the equation and the equation itself. The results are then computed for the strategy.

It is recommended that the agency conduct a more detailed emissions study of the project as it develops further. As a result, this analysis should not be used for conformity purposes.

Traffic Management Center Upgrade – Phase 2 – Design and Construction

The City of El Paso seeks to implement phased updates to the City's Traffic Management Center (TMC). The second phase of these improvements consists of the following:

Upgrades to Communications and Controllers

- Ethernet/IP-based communications to all traffic elements (fiber optic/wireless/ethernet-over-copper)
- Infrastructure to support next generation transportation technologies.
  - Connected Vehicles
  - Connected vehicle infrastructure
  - Autonomous vehicle
  - Internet of things

Data Sources

The City of El Paso provided items containing project information and data including project description and cost estimates. These resources provided the research team with a better understanding of the proposed project and potential emissions benefits.

Emission rates used in the analyses were obtained from the U.S. Environmental Protection Agency's MOVES2014a model. TTI staff created MOVES2014a output files using MOVES input parameters consistent with the latest TCEQ periodic emissions inventories, i.e., the 2017 AERR inventories for El Paso County documented in "*Development of 2017 On-Road Mobile Source Annual, Summer Work Weekday, and Winter Work Weekday Emissions Inventories for Specified Areas: El Paso Area*" (TTI, August 2019), with adjustments as needed for 2030 future analysis year. Local parameters include: meteorological, fuels, fuel fractions, age distributions, Inspection and Maintenance Program. The input files used to generate emission rates are consistent with those used for conformity analysis.

El Paso regional vehicle fleet mix fractions were derived from the TTI study *Production of Statewide Non-Link-Based, On-Road Emissions Inventories with the MOVES Model for the Eight-Hour Ozone Standard Attainment Demonstration Modeling*, conducted in August 2013.

Traffic data for the city roadways was garnered from TxDOT traffic count data for the El Paso District available online, along with El Paso MPO data. A growth rate was estimated and applied to the numbers.

Analysis Methods

TTI staff used the analysis method provided in the August 2008 version of the MOSERs Guide, Equation 7.4 – *Intelligent Transportation Systems (ITS)*. The equation estimates the sum of each ITS link's change in running exhaust emissions resulting from improved traffic flow due to the ITS improvements. In this case, a link is an individual intersection. As the projects are inter-connected with each other and, in some cases, are installed on the same roadways, it is more conducive to analyzed them as one large project then apportion the any emissions benefit to each component. The equation is provided below in Strategy Equation.

The equation is valid for CMAQ purposes but a more robust analysis that models the hundreds of individual intersections would provide a more accurate estimate of the emissions benefits derived from the improvements.

Assumptions in the MOVES2014a output for the project included:

- Output created for VOC, CO, NOx, and PM-10.
- The analysis year is 2030.
- Light-duty passenger vehicles and light-duty passenger trucks (SUVs), motorcycles, light commercial trucks, single unit short and long-haul trucks, and combination short and long-haul trucks, gasoline and diesel-fueled, are included according to a projected regional VMT fleet mix (Source Type ID 11, 21, 31, 32, 41, 42, 43, 51, 52, 53, 54, 61, 62).
- Running exhaust and evaporative emissions, break wear and tire wear emissions rates were calculated.
- Considering the project area and the type of emissions reduced through the strategy, emissions on Road Type 5, urban unrestricted access were analyzed.
- An average city network speed improvement from 30 mph to 35 mph is assumed (speed bin 7 to speed bin 8) as a result of implementation.
- The analysis period is from 6:00 a.m. to 6:00 p.m. on a winter weekday for CO; the same periods on a summer weekday for NOx, VOC, and PM-10. The effects of the signalization program can occur throughout the day, but the greatest impact on emissions will occur with any peak hour or daytime activity.
- The emissions reduced as a result of project were distributed across the 12 hours and by vehicle types and fuel types in line with the vehicle fleet mix in the El Paso region.

TTI staff reviewed the project information to determine values for the individual variables in the MOSERs equation. The MOSERS Guide encourages planners to make conservative, justifiable assumptions about projects.

The following assumptions were made for the project:

- A 2030 average daily VMT of 21,500,000 is estimated for the roadway segments affected by installation of the equipment. Factoring in the disparate AADT and ADT numbers throughout the City, along with El Paso MPO regional VMT numbers, the estimate seems reasonable enough to capture the benefit from the project. Future VMT is estimated based on the estimated current number plus application of a 1.105 percent annual growth factor.
- Assumes 80% of the daily traffic along the roadways occurs in the 12-hour daytime period under analysis. It is also assumed that the traffic will be affected by 80% of the intersections in the City. Thus, projected 2030 citywide daily VMT affected by the program is 14,077,700.
- Total project length of 600 miles is computed.
- Twenty-five (25) percent of total estimate of emissions reduction applied to Phase 2.

The emission reductions are presented in kilograms per day (kg/day) in accordance to CMAQ project reporting requirements.

Strategy Equation

Equation 7.4, Intelligent Transportation Systems (ITS)

Daily Emission Reduction = $\sum_{i=1}^{n}[\mathbf{L}_i * \mathbf{ADT}_i * (\mathbf{EF}_B - \mathbf{EF}_A)_i]$

The sum of each ITS link's change in running exhaust emissions resulting from improved traffic flow.

Variables:

ADT_i: Average daily traffic for each affected roadway

EF_A: Speed-based running exhaust emission factor after implementation (NO_x and VOC) (grams/mile)

EF_B: Speed-based running exhaust emission factor before implementation (NO_x and VOC) (grams/mile)

L_i: Length of each freeway affected by signalization program (miles)

N: Number of affected corridors

For this analysis, the **L** and **ADT** are essentially the estimated VMT (14,077,770) affected by the project. The VMT was distributed through the 12-hour analysis period and multiplied by the result of the emission rate differences. This created a total estimated emissions reduction for the 2030 analysis year for the final, implemented project shown in the table below.

Table 1. Total Estimated Emissions Reduction from Multi-Phase TMC Upgrade Project (2020 Update)

Pollutant	Emissions Reduction (kg/day)
CO	1,360.54
NOx	178.15
VOC	70.04
PM_{10}	203.03

Twenty-five percent of this total estimate was applied to Phase 2. Five percent was allocated to the previous Phase 1 design phase. The remaining 70 percent will be available for Phases 3-5 CMAQ applications.

Summary of Results

The emissions analysis results for the Phase 2 design and construction of the City's signalization project are shown in Table 2. The analysis shows a significant emissions benefit in the El Paso region can be expected from this project.

Table 2. Estimated Emissions Benefits from Traffic Management Center Upgrade – Phase 2 – Design and Construction

Pollutant	Emissions Reduction (kg/day)
CO	340.135
NOx	44.538
VOC	17.510
PM_{10}	50.758

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Emission Reduction Analysis for City of El Paso Proposed CMAQ Project

Border Highway West Hike and Bike Trail (Racetrack to Executive Center)

March 2020

Prepared for

By

Task Summary

The Texas A&M Transportation Institute (TTI) was tasked by the City of El Paso to perform a mobile source emissions analysis for a proposed project in the El Paso metropolitan region. The city is seeking funding from the Congestion Mitigation/Air Quality Improvement Program (CMAQ) to help implement the project.

The project will construct 0.76 miles of hike and bike lane infrastructure improvements along Border Highway West.

Individual Project Analysis

The emissions analysis for the project is presented below. The project name is given along with a brief description of the project. Data sources and analysis assumptions are provided. The equation used from the *Texas Guide to Accepted Mobile Source Emission Reduction Strategies* (MOSERs Guide) is given for the strategy along with the variables of the equation and the equation itself. The results are then computed for the strategy.

It is recommended that the agency conduct a more detailed emissions study of the project as it develops further. The results presented below are valid for CMAQ applications, but more time and effort would increase the accuracy of the emissions benefits. As a result, this analysis should not be used for conformity purposes.

Border Highway West Hike and Bike Trail

The Border Highway West Hike and Bike Trail project will install 0.76 miles of pedestrian and bicycle lane improvements. These include an 11-foot asphalt pavement with irrigated landscaping. The limits of the improvements are from the racetrack interchange to the Executive Center Dr. interchange.

The project will serve the City of El Paso by increasing its regional infrastructure coupled with existing transit projects, educational centers, and commercial developments. Bicycle facilities support and provide connectivity to existing bicycle facilities Citywide with connection to mass transit centers and facilities, and also provide an alternative method of transportation.

The components of the project are consistent with the City of El Paso Bike Plan.

Data Sources

The City of El Paso provided the project description and scope. These resources provided the research team with a better understanding of the proposed project and potential emissions benefits.

The primary source for emission rates inputs and VMT factors (hourly factors and vehicle type VMT mix) for post-processing was the latest TCEQ periodic emissions inventories, i.e., the 2017 AERR inventories for El Paso County documented in *Development of 2017 On-Road Mobile Source Annual, Summer Work Weekday, and Winter Work Weekday Emissions Inventories for Specified Areas: El Paso Area* (TTI, August 2019). For VMT mix, the latest 2030 TxDOT El Paso District estimates were used.

TTI staff used American Community Survey data to compute a bicycle mode share for El Paso, along with a future growth rate for the mode in the region. Researchers reviewed Strava bicycle count data available online.

Analysis Methods

TTI staff used the analysis method provided in the August 2008 version of the MOSERs Guide, Equation 11.1 – *Bicycle and Pedestrian Lanes or Paths*.

Stated in words, the average annual daily traffic (AADT) of the corridor is multiplied by the percentage of drivers shifting to bicycle mode, multiplied by the bike facility length, multiplied by the speed-based running exhaust emission factor for participants' trip before utilizing the bike lane.

The detailed equation is provided below in Strategy Equation.

The analysis year used is 2030. *For planning purposes, the emissions benefit of a static program will decline over time.* Without the increased use of the bike lanes over the project lifetime, any benefits accrued by the mode shift to bicycles may be negated by the increased emissions from potential higher traffic volumes in the corridor over time.

Assumptions in the MOVES2014a output for the project included:

- Output created for CO, VOC, NOx, and PM-10.
- Light-duty passenger vehicles and light-duty passenger trucks (SUVs), gasoline and diesel-fueled, are included according to a projected regional VMT fleet mix (Source Type ID 21, 31)
- Running exhaust, evaporative emissions, brake wear, tire wear, and start emissions rates were calculated. (Process ID 1, 2, 11, 12, 13, 15)
- Considering the project area and the type of trips reduced through the strategy, emissions on Road Type 5, urban unrestricted access were analyzed.
- Overall average speed in the seven roadways is assumed to be 30 mph (Speed bin 7).
- The analysis period is from 7:00 a.m. to 7:00 p.m. on a winter weekday for CO; the same periods on a summer weekday for NOx, VOC, and PM-10. Use of the bicycle lanes can occur throughout the day, but the greatest impact on emissions will occur with any peak hour or daytime mode shift.
- The vehicle-miles traveled (VMT) reduced as a result of the mode shift to bicycle were distributed proportionally across the 12 hours and by vehicle types and fuel types in line with the vehicle fleet mix in the El Paso region.

TTI staff reviewed the project information to determine values for the individual variables in the MOSERs equation. The MOSERS Guide encourages planners to make conservative, justifiable assumptions about projects. TTI staff determined a valid percentage mode shift from automobile to bicycle by participants in El Paso region. The characteristics of this new facility may provide impetus for significant mode shift, but planners should use available data.

The following assumptions were made for the project:

- Light-duty passenger vehicle and light-duty passenger truck AADT in the project area of 13,932 is estimated. This figure is based on AADT and ADT traffic counts from TxDOT and the City of El Paso. AADT is estimated based on the data plus a professional estimate of traffic growth and an averaging of the counts. It assumes 80% of the daily traffic along the roadways occurs in the 12-hour daytime period under analysis. It assumes 86% of the traffic is passenger vehicles.
- The current percent bicycle mode share for the El Paso region is estimated to be 2.0% and can serve as an optimistic mode share increase for the new bike facilities.
- The 0.02 increase in mode share represents new cyclists (vehicle trips replaced). Based on current Strava data along W. Paisano Dr. (US 85), this should be considered very optimistic.
- Bike lane facility length of 0.76 miles is computed.

The emission reductions are presented in kilograms per day (kg/day) in accordance to CMAQ project reporting requirements.

Strategy Equation

Equation 11.1, Bicycle and Pedestrian Lanes or Paths

Daily Emission Reduction = AADT * PMS * L * EF_B

The average annual daily traffic of the corridor multiplied by the percentage of drivers shifting to bike/pedestrian multiplied by the average bicycle trip length multiplied by the speed-based running exhaust emission factor for participants' trip before participating in the bike/pedestrian program.

Final unit of measure: grams/day
Source: Capitol Area MPO (CAMPO)

Variables: **AADT:** Average annual daily traffic in corridor (vehicles/day)

EF_B: Speed-based running exhaust and start emissions factor for participants' trip before participating in the bike/pedestrian program (NO_x, VOC, or CO) (grams/mile)

L: Length of facility (miles)

PMS: Percentage mode shift from driving to bike/pedestrian (decimal)

Analysis

Results

Daily Emission Reduction = AADT * PMS * L * EF_B

Note: Due to the large amount of data generated by the MOVES model and the required off-model computations, for presentation purposes the individual running and start emissions rates are not provided in the results below.

For CO:

13,932 * 0.02 * 0.76 * EF_B = 2.964 kg/day

For NOx:

13,932 * 0.02 * 0.76 * EF_B = 0.164 kg/day

For VOC:

13,932 * 0.02 * 0.76 * EF_B = 0.221 kg/day

For PM-10:

13,932 * 0.02 * 0.76 * EF_B = 0.221 kg/day

Summary of Results

The overall emissions analysis results for the project are shown in Table 1. The estimated emissions benefits from the pedestrian and bicycle facilities are modest and dependent on increased use of bicycles as a travel mode in the city and region, however an emissions benefit in the El Paso region can be expected from this project.

Table 1. Estimated Emissions Benefits from Border Highway West Hike and Bike Trail

Pollutant	Emissions Reduction (kg/day)
CO	2.964
NOx	0.164
VOC	0.221
PM_{10}	0.014

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Emission Reduction Analysis for City of El Paso Proposed CMAQ Project

Downtown Bicycle Improvements Phase I

October 2019

Prepared for

THE CITY OF EL PASO TEXAS

By

Texas A&M Transportation Institute

Task Summary

The Texas A&M Transportation Institute (TTI) was tasked by the City of El Paso to perform a mobile source emissions analysis for a proposed project in the El Paso metropolitan region. The city is seeking funding from the Congestion Mitigation/Air Quality Improvement Program (CMAQ) to help implement the project.

The project will construct 3.5 miles of bike lane infrastructure improvements in the City downtown area.

Individual Project Analysis

The emissions analysis for the project is presented below. The project name is given along with a brief description of the project. Data sources and analysis assumptions are provided. The equation used from the *Texas Guide to Accepted Mobile Source Emission Reduction Strategies* (MOSERs Guide) is given for the strategy along with the variables of the equation and the equation itself. The results are then computed for the strategy.

It is recommended that the agency conduct a more detailed emissions study of the project as it develops further. The results presented below are valid for CMAQ applications, but more time and effort would increase the accuracy of the emissions benefits. As a result, this analysis should not be used for conformity purposes.

Downtown Bicycle Improvements - Phase I

The Downtown Bicycle Improvements - Phase I project will install 3.5 miles of bicycle lane improvements along 10 roadways in the El Paso downtown region. The project will serve the City of El Paso by increasing its regional bike infrastructure coupled with existing transit projects, educational centers, and commercial developments. Bicycle facilities will support and provide connectivity to existing bicycle facilities citywide with connection to mass transit centers and facilities and provide an alternative method of transportation. The infrastructure will be installed within City right-of-way and no property acquisition is anticipated.

The project will construct bicycle facilities downtown to include: buffered bike lanes, conventional bike lanes, bicycle boulevards, shared lane markings, and protected bicycle lanes. The project will include road diets, associated signage, wayfinding, striping, and intersection treatments.

The limits of the improvements involve several roadways:

Limit from:
Campbell from Missouri; El Paso from Sheldon; Main from Oregon; Mills from Sheldon; Missouri from Santa Fe; Myrtle from Stanton; San Antonio from Anthony; Sheldon from Santa Fe; Virginia to Mills; Magoffin from San Antonio

Limit to:
Campbell to Paisano; El Paso to Overland; Main to Campbell; Mills to Virginia; Missouri to Campbell; Myrtle to Campbell; San Antonio to Virginia; Sheldon to El Paso; Virginia to San Antonio; Magoffin to Virginia

The components of the project are part of the August 2016 City of El Paso Bike Plan.

Data Sources

The City of El Paso provided the project description and scope, along with project information and data for the analysis. These resources provided the research team with a better understanding of the proposed project and potential emissions benefits.

The technical report *2017 On-Road Mobile Source Annual, Summer Weekday and Winter Workday Emissions Inventories: El Paso Area, TTI, August 2019* describes development of 2017 analysis year El Paso MOVES2014-based actual on-road inventories, which were the basis for these MOVES runs, with respect to MOVES modeling procedures and MOVES input data. MOVES modeling set-ups and input data combinations are described starting on Page 33 of the report, in the section "Estimation of Seasonal Weekday Emissions Rates". Tables 21 through 30 and surrounding text contain the details. The MOVES modeling part of the process and the local/default input data combinations as described (Table 24) were used, updated where appropriate for model version (MOVES2014a versus MOVES2014) and for analysis year (CMAQ years 2030 versus 2017).

The actual fuel formulation sulfur values were adjusted to reflect "expected" future year values in place of actual average sulfur level values (i.e., to maintain consistency with the Tier 3 gasoline standard implemented in January 2017 and for consistency with Ultra Low Sulfur Diesel). It is also noteworthy that the age distributions and AVFT input data from the 2017 analysis were used, since these are based on the latest available TxDMV vehicle registrations data.

TTI staff used American Community Survey data to compute a bicycle mode share for El Paso, along with a future growth rate for the mode in the region.

Analysis Methods

TTI staff used the analysis method provided in the August 2008 version of the MOSERs Guide, Equation 11.1 – *Bicycle and Pedestrian Lanes or Paths*.

Stated in words, the average annual daily traffic (AADT) of the corridor is multiplied by the percentage of drivers shifting to bicycle mode, multiplied by the bike facility length, multiplied by the speed-based running exhaust emission factor for participants' trip before utilizing the bike lane.

The detailed equation is provided below in Strategy Equation.

The analysis year used is 2030. *For planning purposes, the emissions benefit of a static program will decline over time.* Without the increased use of the bike lanes over the project lifetime, any benefits accrued by the mode shift to bicycles may be negated by the increased emissions from potential higher traffic volumes in the corridor over time.

Assumptions in the MOVES2014a output for the project included:

- Output created for VOC, CO, NOx, and PM-10.
- Light-duty passenger vehicles and light-duty passenger trucks (SUVs), gasoline and diesel-fueled, are included according to a projected regional VMT fleet mix (Source Type ID 21, 31)
- Running exhaust and evaporative emissions, start emissions, and brake wear and tire wear rates were calculated. (Process ID 1, 2, 9, 10, 11, 12, 13, 15, 16)
- Considering the project area and the type of trips reduced through the strategy, emissions on Road Type 5, urban unrestricted access were analyzed.
- Overall average speed in the seven roadways is assumed to be 30 mph (Speed bin 7).
- The analysis period is from 7:00 a.m. to 7:00 p.m. on a winter weekday for CO; the same periods on a summer weekday for NOx, VOC, and PM-10. Use of the bicycle lanes can occur throughout the day, but the greatest impact on emissions will occur with any peak hour or daytime mode shift.
- The vehicle-miles traveled (VMT) reduced as a result of the mode shift to bicycle were distributed proportionally across the 12 hours and by vehicle types and fuel types in line with the vehicle fleet mix in the El Paso region.

TTI staff reviewed the project information to determine values for the individual variables in the MOSERs equation. The MOSERS Guide encourages planners to make conservative, justifiable assumptions about projects. TTI staff determined a valid percentage mode shift from automobile to bicycle by participants in El Paso region. The characteristics of this new facilities may provide impetus for significant mode shift, but planners should use available data.

The following assumptions were made for the project:

- Light-duty passenger vehicle and light-duty passenger truck 2030 AADT of 51,228 is estimated. This figure is based on 2014 ADT traffic counts from the City of El Paso. AADT is estimated based on the data plus a professional estimate of traffic growth and an averaging of the counts. It assumes 80% of the daily traffic along the roadways occurs in the 12-hour daytime period under analysis. It assumes 86% of the traffic is passenger vehicles.
- The current percent bicycle mode share for the El Paso region is estimated to be 2.0% and can serve as an optimistic mode share increase for the new bike facilities.
- The 0.02 increase in mode share represents new cyclists (vehicle trips replaced).
- Bike lane facility length of 3.5 miles is computed.

The emission reductions are presented in kilograms per day (kg/day) in accordance to CMAQ project reporting requirements.

Strategy Equation

Equation 11.1, Bicycle and Pedestrian Lanes or Paths

Daily Emission Reduction = AADT * PMS * L * EF$_B$

The average annual daily traffic of the corridor multiplied by the percentage of drivers shifting to bike/pedestrian multiplied by the average bicycle trip length multiplied by the speed-based running exhaust emission factor for participants' trip before participating in the bike/pedestrian program.

Final unit of measure: grams/day
Source: Capitol Area MPO (CAMPO)

Variables: **AADT:** Average annual daily traffic in corridor (vehicles/day)

EF$_B$: Speed-based running exhaust emission factor for participants' trip before participating in the bike/pedestrian program (NO_x, VOC, or CO) (grams/mile)

L: Length of facility (miles)

PMS: Percentage mode shift from driving to bike/pedestrian (decimal)

Analysis

Results

Daily Emission Reduction = AADT * PMS * L * EF$_B$

Note: Due to the large amount of data generated by the MOVES model and the required off-model computations, for presentation purposes the individual emissions rates are not provided in the results below.

For CO:

51,228 * 0.02 * 3.5 * EF_B = 3,778.188 grams/day

Daily emission reduction is equal to 3.778 kg/day

For NOx:

51,228 * 0.02 * 3.5 * EF_B = 118.226 grams/day

Daily emission reduction is equal to 0.118 kg/day

For VOC:

51,228 * 0.02 * 3.5 * EF_B = 203.159 grams/day

Daily emission reduction is equal to 0.203 kg/day

For PM-10:

51,228 * 0.02 * 3.5 * EF_B = 196.361 grams/day

Daily emission reduction is equal to 0.196 kg/day

Summary of Results

The overall emissions analysis results for the project are shown in Table 1. The estimated emissions benefits from the new bike lanes are significant and are dependent on increased use of bicycles as a travel mode in the city and region, therefore an emissions benefit in the El Paso region can be expected from this project.

Table 1. Estimated Emissions Benefits from Downtown Bicycle Improvements – Phase I

Pollutant	Emissions Reduction (kg/day)
CO	3.778
NOx	0.118
VOC	0.203
PM_{10}	0.196

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Emission Reduction Analysis for City of El Paso Proposed CMAQ Project

Traffic Management Center Upgrade Phase 3 - Construction

March 2020

Prepared for

THE CITY OF EL PASO TEXAS

By

Texas A&M Transportation Institute

Task Summary

The Texas A&M Transportation Institute (TTI) was tasked by the City of El Paso to perform a mobile source emissions analysis for a proposed project in the El Paso metropolitan region. The city is seeking funding from the Congestion Mitigation/Air Quality Improvement Program (CMAQ) to begin the phased implementation of improvements to the City's Traffic Management Center.

Individual Project Analysis

The emissions analysis for the project is presented below. The project name is given along with a brief description of the project. Data sources and analysis assumptions are provided. The equation used from the *Texas Guide to Accepted Mobile Source Emission Reduction Strategies* (MOSERs Guide) is given for the strategy along with the variables of the equation and the equation itself. The results are then computed for the strategy.

It is recommended that the agency conduct a more detailed emissions study of the project as it develops further. As a result, this analysis should not be used for conformity purposes.

Traffic Management Center Upgrade – Phase 3 - Construction

The City of El Paso seeks to implement phased updates to the City's Traffic Management Center (TMC). The third phase of these improvements consists of the following:

Upgrades to Communications and Controllers

- Latest Advanced Traffic Management Systems (ATMS)
- Latest Advanced Transportation Controllers
- Adaptive Traffic Control Systems (ATCS)
- Multi-Modal Transportation Solutions, to include the following:
    - Transit signal priority for mass transit vehicles
    - Pre-emption for Emergency Vehicles
    - Bicyclists
    - Pedestrians
- Hybrid or high-resolution vehicle detection technologies (Radar, Video, microwave)
- Changeable Message Signs (CMS)

Data Sources

The City of El Paso provided items containing project information and data including project description and cost estimates. These resources provided the research team with a better understanding of the proposed project and potential emissions benefits.

Emission rates used in the analyses were obtained from the U.S. Environmental Protection Agency's MOVES2014a model. TTI staff created MOVES2014a output files using MOVES input parameters consistent with the latest TCEQ periodic emissions inventories, i.e., the 2017 AERR inventories for El Paso County documented in "*Development of 2017 On-Road Mobile Source Annual, Summer Work Weekday, and Winter Work Weekday Emissions Inventories for Specified Areas: El Paso Area*" (TTI, August 2019), with adjustments as needed for 2030 future analysis year. Local parameters include: meteorological, fuels, fuel fractions, age distributions, Inspection and Maintenance Program. The input files used to generate emission rates are consistent with those used for conformity analysis.

El Paso regional vehicle fleet mix fractions were derived from the TTI study *Production of Statewide Non-Link-Based, On-Road Emissions Inventories with the MOVES Model for the Eight-Hour Ozone Standard Attainment Demonstration Modeling*, conducted in August 2013.

Traffic data for the city roadways was garnered from TxDOT traffic count data for the El Paso District available online, along with El Paso MPO data. A growth rate was estimated and applied to the numbers.

Analysis Methods

TTI staff used the analysis method provided in the August 2008 version of the MOSERs Guide, Equation 7.4 – *Intelligent Transportation Systems (ITS)*. The equation estimates the sum of each ITS link's change in running exhaust emissions resulting from improved traffic flow due to the ITS improvements. In this case, a link is an individual intersection. As the projects are inter-connected with each other and, in some cases, are installed on the same roadways, it is more conducive to analyzed them as one large project then apportion the any emissions benefit to each component. The equation is provided below in Strategy Equation.

The equation is valid for CMAQ purposes but a more robust analysis that models the hundreds of individual intersections would provide a more accurate estimate of the emissions benefits derived from the improvements.

Assumptions in the MOVES2014a output for the project included:

- Output created for VOC, CO, NOx, and PM-10.
- The analysis year is 2030.
- Light-duty passenger vehicles and light-duty passenger trucks (SUVs), motorcycles, light commercial trucks, single unit short and long-haul trucks, and combination short and long-haul trucks, gasoline and diesel-fueled, are included according to a projected regional VMT fleet mix (Source Type ID 11, 21, 31, 32, 41, 42, 43, 51, 52, 53, 54, 61, 62).
- Running exhaust and evaporative emissions, break wear and tire wear emissions rates were calculated.
- Considering the project area and the type of emissions reduced through the strategy, emissions on Road Type 5, urban unrestricted access were analyzed.
- An average city network speed improvement from 30 mph to 35 mph is assumed (speed bin 7 to speed bin 8) as a result of implementation.
- The analysis period is from 6:00 a.m. to 6:00 p.m. on a winter weekday for CO; the same periods on a summer weekday for NOx, VOC, and PM-10. The effects of the signalization program can occur throughout the day, but the greatest impact on emissions will occur with any peak hour or daytime activity.
- The emissions reduced as a result of project were distributed across the 12 hours and by vehicle types and fuel types in line with the vehicle fleet mix in the El Paso region.

TTI staff reviewed the project information to determine values for the individual variables in the MOSERs equation. The MOSERS Guide encourages planners to make conservative, justifiable assumptions about projects.

The following assumptions were made for the project:

- A 2030 average daily VMT of 21,500,000 is estimated for the roadway segments affected by installation of the equipment. Factoring in the disparate AADT and ADT numbers throughout the City, along with El Paso MPO regional VMT numbers, the estimate seems reasonable enough to capture the benefit from the project. Future VMT is estimated based on the estimated current number plus application of a 1.105 percent annual growth factor.
- Assumes 80% of the daily traffic along the roadways occurs in the 12-hour daytime period under analysis. It is also assumed that the traffic will be affected by 80% of the intersections in the City. Thus, projected 2030 citywide daily VMT affected by the program is 14,077,700.
- Total project length of 600 miles is computed.
- Twenty-five (25) percent of total estimate of emissions reduction applied to Phase 3.

The emission reductions are presented in kilograms per day (kg/day) in accordance to CMAQ project reporting requirements.

Strategy Equation

Equation 7.4, Intelligent Transportation Systems (ITS)

Daily Emission Reduction = $\sum_{i=1}^{n}[\mathbf{L}_i * \mathbf{ADT}_i * (\mathbf{EF}_B - \mathbf{EF}_A)_i]$

The sum of each ITS link's change in running exhaust emissions resulting from improved traffic flow.

Variables:

ADT_i: Average daily traffic for each affected roadway

EF_A: Speed-based running exhaust emission factor after implementation (NO_x and VOC) (grams/mile)

EF_B: Speed-based running exhaust emission factor before implementation (NO_x and VOC) (grams/mile)

L_i: Length of each freeway affected by signalization program (miles)

N: Number of affected corridors

For this analysis, the **L** and **ADT** are essentially the estimated VMT (14,077,770) affected by the project. The VMT was distributed through the 12-hour analysis period and multiplied by the result of the emission rate differences. This created a total estimated emissions reduction for the 2030 analysis year for the final, implemented project shown in Table 1 below.

Table 1. Total Estimated Emissions Reduction from Multi-Phase TMC Upgrade Project (2020 Update)

Pollutant	Emissions Reduction (kg/day)
CO	1,360.54
NOx	178.15
VOC	70.04
PM_{10}	203.03

Twenty-five percent of this total estimate was applied to Phase 2. Five percent was allocated to the previous Phase 1 design phase, 25 percent to the proposed Phase 2. The remaining 45 percent will be available for Phases 4-5 CMAQ applications.

Summary of Results

The emissions analysis results for the Phase 3 construction of the City's traffic signalization project are shown in Table 2. The analysis shows a significant emissions benefit in the El Paso region can be expected from this project.

Table 2. Estimated Emissions Benefits from Traffic Management Center Upgrade – Phase 3 Construction

Pollutant	Emissions Reduction (kg/day)
CO	340.135
NOx	44.538
VOC	17.510
PM_{10}	50.758

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Emission Reduction Analysis for City of El Paso Proposed CMAQ Project

Dyer Street Pedestrian and Parkway Improvements

October 2021

Prepared for

The City of El Paso, Texas

By

Texas A&M Transportation Institute

Task Summary

The Texas A&M Transportation Institute (TTI) was tasked by the City of El Paso to perform a mobile source emissions analysis for a proposed project in the El Paso nonattainment area. The city is seeking funding from the Congestion Mitigation/Air Quality Improvement Program (CMAQ) to help implement the project.

The project will construct 0.2 miles of pedestrian infrastructure improvements along Dyer St.

Individual Project Analysis

The emissions analysis for the project is presented below. The project name is given along with a brief description of the project. Data sources and analysis assumptions are provided. The equation used from the *Texas Guide to Accepted Mobile Source Emission Reduction Strategies* (MOSERs Guide) is given for the strategy along with the variables of the equation and the equation itself. The results are then computed for the strategy.

It is recommended that the agency conduct a more detailed emissions study of the project as it develops further. The results presented below are valid for CMAQ applications, but more time and effort would increase the accuracy of the emissions benefits. As a result, *this analysis should not be used for conformity purposes*.

Dyer Street Pedestrian and Parkway Improvements

The Dyer Street Pedestrian and Parkway Improvements project will install 0.2 miles of pedestrian improvements. The project will serve the City of El Paso by addressing pedestrian safety issues and improve the multi-modal capacity of the roadway. These improvements include improved sidewalks, landscaping, irrigation, and striping along Dyer St. The project limits are from Gateway North to Hercules Ave.

Data Sources

The City of El Paso provided the project description and scope. These resources provided the research team with a better understanding of the proposed project and potential emissions benefits.

Emission rates used in the analyses were obtained from the U.S. Environmental Protection Agency's MOVES2014b model. TTI staff utilized recently updated emission rate lookup tables (ERLTs) of on-road mobile source emission rates for Texas regions (TTI, May 2021). The updated ERLTs incorporate changes such as updates to the U.S. Environmental Protection Agency's (EPA) motor vehicle emissions model (MOVES2014b, released August 2018, and the latest version of MOVES at the start of the ERLT development project), vehicle and fuel characteristics, weather characteristics, and vehicle miles traveled (VMT) mix. These ERLTs were developed for various TxDOT districts, including El Paso, for use in investigating air quality impacts of proposed transportation projects and mitigation strategies. The tables provide emission rates needed to convert quantities such as VMT, intersection delays, truck stop idling, and vehicle starts to total emissions.

TTI staff used American Community Survey data to compute an increased pedestrian mode share for El Paso, along with a future growth rate for the mode in the region.

Analysis Methods

TTI staff used the analysis method provided in the State of Texas MOSERs Guide, Equation 11.1 – *Bicycle and Pedestrian Lanes or Paths*.

Stated in words, the average annual daily traffic (AADT) of the corridor is multiplied by the percentage of drivers shifting to pedestrian mode, multiplied by the project length, multiplied by the speed-based running exhaust emission factor for participants' trip before utilizing the pedestrian facility.

The detailed equation is provided below in Strategy Equation.

The analysis year used is 2030. *For planning purposes, the emissions benefit of a static program will decline over time.* Without the increased use of the sidewalks over the project lifetime, any benefits accrued by the mode shift to pedestrian will be negated by the increased emissions from potential higher traffic volumes in the corridor over time.

Assumptions in the MOVES2014b output for the project included:

- Output created for CO, VOC, NOx, and PM-10.

- Light-duty passenger vehicles and light-duty passenger trucks (SUVs), gasoline and diesel-fueled, are included according to a projected regional VMT fleet mix (Source Type ID 21, 31)
- Running exhaust, evaporative emissions, brake wear, tire wear, and start emissions rates were calculated. (Process ID 1, 2, 9, 10, 11, 12, 13, 15, 16)
- Considering the project area and the type of trips reduced through the strategy, emissions on Road Type 5, urban unrestricted access were analyzed.
- Overall average speed in the seven roadways is assumed to be 30 mph (Speed bin 7).
- The analysis period is from 7:00 a.m. to 7:00 p.m. on a winter weekday for CO; the same periods on a summer weekday for NOx, VOC, and PM-10. Use of the sidewalks can occur throughout the day, but the greatest impact on emissions will occur with any peak hour or daytime mode shift.
- The vehicle-miles traveled (VMT) reduced as a result of the mode shift to pedestrian were distributed proportionally across the 12 hours and by vehicle types and fuel types in line with the vehicle fleet mix in the El Paso region.

TTI staff reviewed the project information to determine values for the individual variables in the MOSERs equation. The MOSERS Guide encourages planners to make conservative, justifiable assumptions about projects. TTI staff determined a valid percentage mode shift from automobile to pedestrian by participants in El Paso region. The characteristics of this new facility may provide impetus for significant mode shift, but planners should use available data.

The following assumptions were made for the project:

- Light-duty passenger vehicle and light-duty passenger truck AADT in the project area of 14,104 is estimated. This figure is based on AADT traffic counts from TxDOT and the City of El Paso. AADT is estimated based on the data plus a professional estimate of traffic growth and an averaging of the counts. It assumes 80% of the daily traffic along the roadways occurs in the 12-hour daytime period under analysis. It assumes 86% of the traffic is passenger vehicles.
- The current percent pedestrian mode share for the El Paso region is estimated to be 2.5% and can serve as an optimistic mode share increase for the improved pedestrian facilities.
- The 0.025 increase in mode share represents new pedestrians (vehicle trips replaced). This figure should be considered very optimistic.
- Pedestrian facility length of 0.2 miles is used.

The emission reductions are presented in kilograms per day (kg/day) in accordance to CMAQ project reporting requirements.

Strategy Equation

Equation 11.1, Bicycle and Pedestrian Lanes or Paths

Daily Emission Reduction = AADT * PMS * L * EF_B

The average annual daily traffic of the corridor multiplied by the percentage of drivers shifting to bike/pedestrian multiplied by the average bicycle trip length multiplied by the speed-based running exhaust emission factor for participants' trip before participating in the bike/pedestrian program.

Final unit of measure: grams/day
Source: Capitol Area MPO (CAMPO)

Variables: **AADT:** Average annual daily traffic in corridor (vehicles/day)

EF_B: Speed-based running exhaust and start emissions factor for participants' trip before participating in the bike/pedestrian program (NO_x, VOC, or CO) (grams/mile)

L: Length of facility (miles)

PMS: Percentage mode shift from driving to bike/pedestrian (decimal)

Analysis

Due to the large amount of data generated by the MOVES model and the required off-model computations, for presentation purposes the individual running and start emissions rates are not provided in the results below.

For CO:

14,104 * 0.025 * 0.2 * EF_B = 0.388 kg/day

For NOx:

14,104 * 0.025 * 0.2 * EF_B = 0.036 kg/day

For VOC:

14,104 * 0.025 * 0.2 * EF_B = 0.028 kg/day

For PM-10:

14,104 * 0.025 * 0.2 * EF_B = 0.001 kg/day

Summary of Results

The overall emissions analysis results for the project are shown in Table 1 below. The estimated emissions benefits from the pedestrian facilities are modest and dependent on increased use of the facilities as a travel mode in the city and region.

Table 1. Estimated Emissions Benefits from Dyer Street Pedestrian and Parkway Improvements

Pollutant	Emissions Reduction (kg/day)
CO	0.388
NOx	0.036
VOC	0.028
PM_{10}	0.001

RMS 2023-2026 TIP

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Emission Reduction Analysis for City of El Paso Proposed CMAQ Project

Traffic Management Center Upgrade Phase 4 - Construction

October 2021

Prepared for

THE CITY OF EL PASO TEXAS

By

Texas A&M Transportation Institute

Task Summary

The Texas A&M Transportation Institute (TTI) was tasked by the City of El Paso to perform a mobile source emissions analysis for a proposed project in the El Paso metropolitan region. The city is seeking funding from the Congestion Mitigation/Air Quality Improvement Program (CMAQ) to continue the phased implementation of improvements to the City's Traffic Management Center.

Individual Project Analysis

The emissions analysis for the project is presented below. The project name is given along with a brief description of the project. Data sources and analysis assumptions are provided. The equation used from the *Texas Guide to Accepted Mobile Source Emission Reduction Strategies* (MOSERs Guide) is given for the strategy along with the variables of the equation and the equation itself. The results are then computed for the strategy.

It is recommended that the agency conduct a more detailed emissions study of the project as it develops further. As a result, *this analysis should not be used for conformity purposes*.

Traffic Management Center Upgrade – Phase 4 - Construction

The City of El Paso seeks to implement phased updates to the City's Traffic Management Center (TMC). The TMC oversees the operation of the City's Transportation Management Center Computerized Signal System. The system includes the signal timing and coordination for approximately 658 traffic signals. The TMC primary objective is incident management, providing real-time response to incidents with the ability to remotely implement emergency signal timing to help ease traffic congestion due to traffic accidents, special events or construction closures. The Traffic Signal controllers are outdated and limit the response capabilities of the TMC. Upgrading the equipment will allow the TMC to mediate congestion and allow for more creative timing of the traffic signal lights for incident management to include adaptive timing.

The fourth phase of these improvements consists of the following:

- Latest Advanced Traffic Management Systems (ATMS)
- Latest Advanced Transportation Controllers
- Adaptive Traffic Control Systems (ATCS)
- Multi-Modal Transportation Solutions, to include the following:
  - Transit signal priority for mass transit vehicles
  - Pre-emption for Emergency Vehicles
  - Bicyclists
  - Pedestrians
- Hybrid or high-resolution vehicle detection technologies (Radar, Video, microwave)
- Changeable Message Signs (CMS)

Data Sources

The City of El Paso provided items containing project information and data including project description and cost estimates. These resources provided the research team with a better understanding of the proposed project and potential emissions benefits.

TTI researchers used MOVES2014b emission rates developed for El Paso using rates and data as described in "*Development of Emission Rate Lookup Tables: Final Report*" prepared for the Texas Department of Transportation by TTI (May 2021). Local input parameters include meteorological; fuels; fuel fractions; age distributions; Inspection and Maintenance Program. Weekday; 24-hour and fleet or sub-fleet composites of individual hourly gasoline and diesel vehicle rates were produced for the analyses using El Paso District fleet and hourly mixes.

Traffic data for the city roadways was garnered from TxDOT traffic count data for the El Paso District available online. A growth rate was estimated and applied to the numbers.

Analysis Methods

TTI staff used the analysis method provided in the State of Texas MOSERs Guide, Equation 7.4 – *Intelligent Transportation Systems (ITS)*. The equation estimates the sum of each ITS link's change in running exhaust emissions resulting from improved traffic flow due to the ITS improvements. The equation is provided below in Strategy Equation.

The equation is valid for CMAQ purposes but a more robust analysis that models the hundreds of individual intersections would provide a more accurate estimate of the emissions benefits derived from the improvements.

Assumptions in the MOVES2014b output for the project included:

- Output created for VOC, CO, NOx, and PM-10.
- The analysis year is 2030.
- Light-duty passenger vehicles and light-duty passenger trucks (SUVs), motorcycles, light commercial trucks, single unit short and long-haul trucks, and combination short and long-haul trucks, gasoline and diesel-fueled, are included according to a projected regional VMT fleet mix (Source Type ID 11, 21, 31, 32, 41, 42, 43, 51, 52, 53, 54, 61, 62).
- Running exhaust and evaporative emissions, break wear and tire wear emissions rates were calculated. (Process ID 1, 9, 10, 11, 12, 13, 15)
- Considering the project area and the type of emissions reduced through the strategy, emissions on Road Type 5, urban unrestricted access were analyzed.
- An average city network speed improvement from 30 mph to 35 mph is assumed (speed bin 7 to speed bin 8) resulting from implementation.
- The analysis period is from 6:00 a.m. to 7:00 p.m. on a winter weekday for CO; the same periods on a summer weekday for NOx, VOC, and PM-10. The effects of the signalization program can occur throughout the day, but the greatest impact on emissions will occur during any peak hours or daytime activity.
- The emissions reduced from the project were distributed across the 13 hours and by vehicle types and fuel types in line with the vehicle fleet mix in the El Paso region.

TTI staff reviewed the project information to determine values for the individual variables in the MOSERs equation. The MOSERS Guide encourages planners to make conservative, justifiable assumptions about projects.

The following assumptions were made for the project:

- A 2030 average daily VMT of 21,500,000 is estimated for the roadway segments affected by installation of the equipment. Factoring in the disparate AADT and ADT numbers throughout the City, along with El Paso MPO regional VMT numbers, the estimate seems reasonable enough to capture the benefit from the project. Future VMT is estimated based on the estimated current number plus application of a 1.105 percent annual growth factor.
- Assumes 80% of the daily traffic along the roadways occurs in the 13-hour daytime period under analysis. It is also assumed that the traffic will be affected by 80% of the intersections in the City. Thus, projected 2030 citywide daily VMT affected by the program is 14,077,700.
- Twenty-five (25) percent of total estimate of emissions reduction applied to Phase 4.

The emission reductions are presented in kilograms per day (kg/day) in accordance with CMAQ project reporting requirements.

Strategy Equation

Equation 7.4, Intelligent Transportation Systems (ITS)

Daily Emission Reduction = $\sum_{i=1}^{n}[\mathbf{L}_i * \mathbf{ADT}_i * (\mathbf{EF}_B - \mathbf{EF}_A)_i]$

The sum of each ITS link's change in running exhaust emissions resulting from improved traffic flow.

Variables:

ADT_i: Average daily traffic for each affected roadway

EF_A: Speed-based running exhaust emission factor after implementation (NO_x and VOC) (grams/mile)

EF_B: Speed-based running exhaust emission factor before implementation (NO_x and VOC) (grams/mile)

L_i: Length of each freeway affected by signalization program (miles)

N: Number of affected corridors

For this analysis, the **L** and **ADT** are essentially the estimated VMT (14,077,770) affected by the project. The VMT was distributed through the 13-hour analysis period and multiplied by the result of the emission rate differences. This created a total estimated emissions reduction for the 2030 analysis year for the final, implemented project shown in Table 1 below.

Table 1. Total Estimated Emissions Reduction from Multi-Phase TMC Upgrade Project (2020 Update)

Pollutant	Emissions Reduction (kg/day)
CO	1,360.54
NOx	178.15
VOC	70.04
PM_{10}	203.03

Twenty-five percent of this total estimate was applied to Phase 4. Five percent was allocated to the previous Phase 1 design phase, 25 percent each to the proposed Phases 2-3. The remaining 20 percent will be available for Phase 5 CMAQ application.

Summary of Results

The emissions analysis results for the Phase 4 construction of the City's traffic signalization project are shown in Table 2. The analysis shows a significant emissions benefit in the El Paso region can be expected from this project.

Table 2. Estimated Emissions Benefits from Traffic Management Center Upgrade – Phase 4 - Construction

Pollutant	Emissions Reduction (kg/day)
CO	340.135
NO_x	44.538
VOC	17.510
PM_{10}	50.758

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Emission Reduction Analysis for City of El Paso Proposed CMAQ Project

Traffic Management Center Upgrade
Phase 5 - Construction

October 2021

Prepared for

By

Texas A&M Transportation Institute

Task Summary

The Texas A&M Transportation Institute (TTI) was tasked by the City of El Paso to perform a mobile source emissions analysis for a proposed project in the El Paso metropolitan region. The city is seeking funding from the Congestion Mitigation/Air Quality Improvement Program (CMAQ) to begin the phased implementation of improvements to the City's Traffic Management Center.

Individual Project Analysis

The emissions analysis for the project is presented below. The project name is given along with a brief description of the project. Data sources and analysis assumptions are provided. The equation used from the *Texas Guide to Accepted Mobile Source Emission Reduction Strategies* (MOSERs Guide) is given for the strategy along with the variables of the equation and the equation itself. The results are then computed for the strategy.

It is recommended that the agency conduct a more detailed emissions study of the project as it develops further. As a result, this analysis should not be used for conformity purposes.

Traffic Management Center Upgrade – Phase 5 - Construction

The City of El Paso seeks to implement phased updates to the City's Traffic Management Center (TMC). The TMC oversees the operation of the City's Transportation Management Center Computerized Signal System. The system includes the signal timing and coordination for approximately 658 traffic signals. The TMC primary objective is incident management, providing real-time response to incidents with the ability to remotely implement emergency signal timing to help ease traffic congestion due to traffic accidents, special events or construction closures. The Traffic Signal controllers are outdated and limit the response capabilities of the TMC. Upgrading the equipment will allow the TMC to mediate congestion and allow for more creative timing of the traffic signal lights for incident management to include adaptive timing.

The fifth phase of these improvements consists of the following:

- Latest Advanced Traffic Management Systems (ATMS)
- Latest Advanced Transportation Controllers
- Adaptive Traffic Control Systems (ATCS)
- Multi-Modal Transportation Solutions, to include the following:
    - Transit signal priority for mass transit vehicles
    - Pre-emption for Emergency Vehicles
    - Bicyclists
    - Pedestrians
- Hybrid or high-resolution vehicle detection technologies (Radar, Video, microwave)
- Changeable Message Signs (CMS)

Data Sources

The City of El Paso provided items containing project information and data including project description and cost estimates. These resources provided the research team with a better understanding of the proposed project and potential emissions benefits.

TTI researchers used MOVES2014b emission rates developed for El Paso using rates and data as described in "*Development of Emission Rate Lookup Tables: Final Report*" prepared for the Texas Department of Transportation by TTI (May 2021). Local input parameters include meteorological; fuels; fuel fractions; age distributions; Inspection and Maintenance Program. Weekday; 24-hour and fleet or sub-fleet composites of individual hourly gasoline and diesel vehicle rates were produced for the analyses using El Paso District fleet and hourly mixes.

Traffic data for the city roadways was garnered from TxDOT traffic count data for the El Paso District available online. A growth rate was estimated and applied to the numbers.

Analysis Methods

TTI staff used the analysis method provided in the State of Texas MOSERs Guide, Equation 7.4 – *Intelligent Transportation Systems (ITS)*. The equation estimates the sum of each ITS link's change in running exhaust emissions resulting from improved traffic flow due to the ITS improvements. The equation is provided below in Strategy Equation.

The equation is valid for CMAQ purposes but a more robust analysis that models the hundreds of individual intersections would provide a more accurate estimate of the emissions benefits derived from the improvements.

Assumptions in the MOVES2014b output for the project included:

- Output created for VOC, CO, NOx, and PM-10.
- The analysis year is 2030.
- Light-duty passenger vehicles and light-duty passenger trucks (SUVs), motorcycles, light commercial trucks, single unit short and long-haul trucks, and combination short and long-haul trucks, gasoline and diesel-fueled, are included according to a projected regional VMT fleet mix (Source Type ID 11, 21, 31, 32, 41, 42, 43, 51, 52, 53, 54, 61, 62).
- Running exhaust and evaporative emissions, break wear and tire wear emissions rates were calculated. (Process ID 1, 9, 10, 11, 12, 13, 15)
- Considering the project area and the type of emissions reduced through the strategy, emissions on Road Type 5, urban unrestricted access were analyzed.
- An average city network speed improvement from 30 mph to 35 mph is assumed (speed bin 7 to speed bin 8) resulting from implementation.
- The analysis period is from 6:00 a.m. to 7:00 p.m. on a winter weekday for CO; the same periods on a summer weekday for NOx, VOC, and PM-10. The effects of the signalization program can occur throughout the day, but the greatest impact on emissions will occur during any peak hours or daytime activity.
- The emissions reduced from the project were distributed across the 13 hours and by vehicle types and fuel types in line with the vehicle fleet mix in the El Paso region.

TTI staff reviewed the project information to determine values for the individual variables in the MOSERs equation. The MOSERS Guide encourages planners to make conservative, justifiable assumptions about projects.

The following assumptions were made for the project:

- A 2030 average daily VMT of 21,500,000 is estimated for the roadway segments affected by installation of the equipment. Factoring in the disparate AADT and ADT numbers throughout the City, along with El Paso MPO regional VMT numbers, the estimate seems reasonable enough to capture the benefit from the project. Future VMT is estimated based on the estimated current number plus application of a 1.105 percent annual growth factor.
- Assumes 80% of the daily traffic along the roadways occurs in the 13-hour daytime period under analysis. It is also assumed that the traffic will be affected by 80% of the intersections in the City. Thus, projected 2030 citywide daily VMT affected by the program is 14,077,700.
- Twenty (20) percent of total estimate of emissions reduction applied to Phase 5.

The emission reductions are presented in kilograms per day (kg/day) in accordance with CMAQ project reporting requirements.

Strategy Equation

Equation 7.4, Intelligent Transportation Systems (ITS)

Daily Emission Reduction = $\sum_{i=1}^{n}[\mathbf{L}_i * \mathbf{ADT}_i * (\mathbf{EF}_B - \mathbf{EF}_A)_i]$

The sum of each ITS link's change in running exhaust emissions resulting from improved traffic flow.

Variables:

ADT_i: Average daily traffic for each affected roadway

EF_A: Speed-based running exhaust emission factor after implementation (NO_x and VOC) (grams/mile)

EF_B: Speed-based running exhaust emission factor before implementation (NO_x and VOC) (grams/mile)

L_i: Length of each freeway affected by signalization program (miles)

N: Number of affected corridors

For this analysis, the **L** and **ADT** are essentially the estimated VMT (14,077,770) affected by the project. The VMT was distributed through the 13-hour analysis period and multiplied by the result of the emission rate differences. This created a total estimated emissions reduction for the 2030 analysis year for the final, implemented project shown in Table 1 below.

Table 1. Total Estimated Emissions Reduction from Multi-Phase TMC Upgrade Project (2020 Update)

Pollutant	Emissions Reduction (kg/day)
CO	1,360.54
NOx	178.15
VOC	70.04
PM_{10}	203.03

Twenty percent of this total estimate was applied to Phase 5. Five percent was allocated to the previous Phase 1 design phase, 25 percent to the implemented and proposed Phases 2-4. The remaining 20 percent is available for the Phase 5 CMAQ application.

Summary of Results

The emissions analysis results for the Phase 5 construction of the City's Traffic Management Center are shown in Table 2. The analysis shows a significant emissions benefit in the El Paso region can be expected from this project.

Table 2. Estimated Emissions Benefits from Traffic Management Center Upgrade – Phase 5 - Construction

Pollutant	Emissions Reduction (kg/day)
CO	272.108
NOx	35.630
VOC	14.008
PM_{10}	40.606

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Emission Reduction Analysis for Sun Metro Proposed CMAQ Project

Montana RTS Operations Assistance Phase 1

March 2020

Prepared for

By

Task Summary

The Texas A&M Transportation Institute (TTI) El Paso office was tasked by Sun Metro to perform a mobile source emissions analysis for a proposed project in the El Paso nonattainment area. The transit agency is seeking funding from the Congestion Mitigation/Air Quality Improvement Program (CMAQ).

The project is operational assistance for the first phase of the Rapid Transit Service, BRIO, in the Montana corridor in east-central El Paso region.

Individual Project Analysis

The emissions analysis for the project is presented below. The strategy name is given along with a brief description of the project. Data sources and analysis assumptions are provided. The equation used from the *Texas Guide to Accepted Mobile Source Emission Reduction Strategies* (MOSERs Guide) is given for the strategy along with the variables of the equation and the equation itself. The results are then computed for the strategy equation.

It is recommended that the agency conduct a more detailed emissions study of the project as it develops further. The results presented below are valid for CMAQ program submission, but this analysis should not be used for conformity purposes.

Montana RTS Operations Assistance - Phase 1

Sun Metro transit agency is proposing operations assistance for the first phase of the 16.8-mile BRIO line in the Montana corridor in east El Paso region. The RTS line begins at the Five Points Terminal and ends at the future Far East Transfer Center. Fourteen buses will operate along the route with 25 stations.

Data Sources

Sun Metro provided several data sources to the TTI team for the analysis: a map of the proposed route, previous emissions analysis for the route, the mileage, hours of operation, and operating costs for the route.

The technical report *2017 On-Road Mobile Source Annual, Summer Weekday and Winter Workday Emissions Inventories: El Paso Area* (TTI, August 2019) describes development of 2017 analysis year El Paso MOVES2014-based actual on-road inventories, which were the basis for these MOVES runs, with respect to MOVES modeling procedures and MOVES input data. MOVES modeling set-ups and input data combinations are described starting on Page 33 of the report, in the section "Estimation of Summer and Winter Weekday Emissions Factors." Tables 22 through 33 and surrounding text contain the details. The MOVES modeling part of the process and the local/default input data combinations as described (Table 24) was used, updated where appropriate for model version and for analysis year.

In particular, the actual fuel formulation sulfur values were adjusted to reflect "expected" future year values in place of 2017 actual average sulfur level values (i.e., to maintain consistency with the Tier 3 gasoline standard and for consistency with Ultra Low Sulfur Diesel). It is also noteworthy that the age distributions and AVFT input data from the 2017 analysis were used, since these are based on the mid-year 2014 TxDMV vehicle registrations data, which is currently still "latest available".

Transit passenger characteristics were derived from the American Public Transportation Association report *A Profile of Public Transportation Passenger Demographics and Travel Characteristics Reported in On-Board Surveys* published in May 2007.

Analysis Methods

TTI staff used the analysis method provided in the August 2008 version of the MOSERs Guide, equation 3.1 - *System/Service Expansion*. The detailed equation is provided below in Strategy Equation.

Stated in words, the equation measures the reduction in start emissions and running exhaust emissions from a change in mode during the operating period and subtracting any additional emissions from the transit vehicles. The benefit is derived through attracting single occupant passenger vehicle drivers to utilize transit as their mode of travel.

The analysis year used is 2022. *For planning purposes, the emissions benefit of a static program will decline over time.*

Assumptions in the MOVES2014a output for the project included:

- Output created for VOC, CO, NOx, and PM-10
- Light-duty passenger vehicles and light-duty passenger trucks (SUVs) vehicle types, gasoline and diesel-fueled, and transit buses are included according to a projected regional VMT fleet mix (Source Type ID 21, 31)
- Transit vehicle (source type 42) emission rates were included as this will be a new service.
- Running exhaust, running evaporative, and start emissions (Process ID 1, 2, 11, 12, 13, 15)
- Considering the project area and the type of trips reduced through the strategy, primarily, freeway commuting, emissions on Road Type 4, urban restricted access, was used for the passenger vehicles. Road type 5, urban unrestricted access, was used for the transit vehicles.
- Average speed on IH-10 during operating hours (peak and off-peak) is assumed 30 mph.
- Average transit vehicle speed is assumed 20 mph (speed bin 5) based on data received from Sun Metro.
- The analysis period is AM peak hours of 6:00-9:00 a.m., off-peak daytime hours from 9:00 a.m.-3:00 p.m. and PM peak hours of 3:00-8:00 p.m. on a winter weekday for CO; the same periods on a summer weekday for NOx, VOC, and PM-10.
- The vehicle trips reduced (VT_R) and vehicle-miles travelled reduced (VMT_R) were distributed proportionally across the 14 hours of model analysis and by vehicle type and fuel type in line with the vehicle fleet mix in the El Paso region.

TTI staff reviewed the project information to determine values for the individual variables in the MOSERs equation. The MOSERS Guide encourages planners to make conservative, justifiable assumptions about projects.

- Based on ridership data provided by Sun Metro, an average daily ridership of 3,300 was assumed.
- APTA ridership survey reports show 52% of transit passengers to be commuting. The RTS project focuses on capturing new commute traffic, so 75% of riders are assumed to be traveling to work and back totaling 2,775 per day.
- The analysis assumes 35% of these commute passengers are former single occupant vehicle (SOV) drivers. This translates to 26.25% of all passengers. This should be considered optimistic. The APTA survey report showed 14.3% of transit roadway passengers would drive alone as an alternative if no transit service was available. However, this new service actively seeks SOV commuters.
- An average trip length of 12.6 miles was computed based on data provided by Sun Metro. The trip lengths were distributed evenly in the reduced VMT.

The final estimated emission reductions are presented in kilograms per day (kg/day) in accordance to CMAQ project reporting requirements.

Strategy Equation

Note: Due to the extensiveness of the MOVES model output data and to help presentation of results, the individual start rates and emission rates per distance ($\mathbf{TEF}_{\boldsymbol{AUTO}}$ and $\mathbf{EF}_{\boldsymbol{B}}$) per vehicle type computed are not presented but are available for review, if needed.

3.1 System/Service Expansion

Daily Emission Reduction (for each pollutant) = A + B – C – D

$$A = VT_R * TEF_{AUTO}$$

Reduction in auto start emissions from trips reduced

$$B = VMT_R * EF_B$$

Reduction in auto running exhaust emissions from VMT reductions

$$C = VT_{BUS} * TEF_{BUS}$$

Increase in emissions from additional bus starts

$$D = VMT_{BUS} * EF_{BUS}$$

Increase in emissions from additional bus running exhaust emissions

Where

$VT_R = N_{TR} * F_{T, SOV}$

Number of new transit riders multiplied by the percentage of riders shifting from single-occupant auto use

$VMT_R = VT_R * TL_W$

Number of vehicle trips reduced multiplied by the average auto trip length

Final unit of measure: grams/day
Source: Texas A&M Transportation Institute

Variables:

EF_B:	Speed-based running exhaust emission factor for affected roadway before implementation (NO_x, VOC, or CO) (grams/mile)
EF_{BUS}:	Speed-based running exhaust emission factor for transit vehicle (NO_x, VOC, or CO) (grams/mile)
$F_{T, SOV}$:	Percentage of people using a transit vehicle that previously were vehicle drivers (decimal)
N_{TR}:	New transit ridership

TEF_{AUTO}: Auto trip-end emission factor (NO_x, VOC, or CO) (grams/trip)

TEF_{BUS}: Bus (or other transit vehicle) trip-end emission factor (NO_x, VOC, or CO) (grams/trip)

TL_W: Average auto trip length (miles)

VMT_{BUS}: VMT by transit vehicle

VMT_R: Reduction in daily automobile VMT

VT_{BUS}: Daily vehicle trips by transit vehicle

VT_R: Reduction in number of daily automobile vehicle trips

Analysis

For presentation purposes, the MOVES calculation results and extensive results from the equation calculations are not presented in the results below.

VT_R = (3,300 * 2) * 0.52 = 3,432 trips/day
Number of transit riders multiplied by 2 multiplied by the percentage of riders shifting from single-occupant auto use

VMT_R = 3,432 * 12.6 = 43,243 vehicle-miles/day
Number of vehicle trips reduced multiplied by the average auto trip length

Summary of Results

The emissions analysis result for the project is shown in Table 1. There are significant emissions benefits for all four pollutants. The results indicate an estimated air quality benefit from the Montana RTS operations assistance project.

Table 1. Montana RTS Operations Assistance Emission Reductions

Pollutant	Emissions Reduction (kg/day)
CO	100.325
NO_x	2.929
VOC	5.553
PM_{10}	1.629

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Emission Reduction Analysis for Sun Metro Proposed CMAQ Project

Montana RTS Operations Assistance
Phase 2

March 2020

Prepared for

sunmetro

By

Texas A&M Transportation Institute

Task Summary

The Texas A&M Transportation Institute (TTI) El Paso office was tasked by Sun Metro to perform a mobile source emissions analysis for a proposed project in the El Paso nonattainment area. The transit agency is seeking funding from the Congestion Mitigation/Air Quality Improvement Program (CMAQ).

The project is operational assistance for the second phase of the Rapid Transit Service, BRIO, in the Montana corridor in east-central El Paso region.

Individual Project Analysis

The emissions analysis for the project is presented below. The strategy name is given along with a brief description of the project. Data sources and analysis assumptions are provided. The equation used from the *Texas Guide to Accepted Mobile Source Emission Reduction Strategies* (MOSERs Guide) is given for the strategy along with the variables of the equation and the equation itself. The results are then computed for the strategy equation.

It is recommended that the agency conduct a more detailed emissions study of the project as it develops further. The results presented below are valid for CMAQ program submission, but this analysis should not be used for conformity purposes.

Montana RTS Operations Assistance - Phase 2

Sun Metro transit agency is proposing operations assistance for the second phase of the 16.8-mile BRIO line in the Montana corridor in east El Paso region. The RTS line begins at the Five Points Terminal and ends at the future Far East Transfer Center. Twelve buses will operate along the route with 26 stations.

Data Sources

Sun Metro provided several data sources to the TTI team for the original analysis: a map of the proposed route, previous emissions analysis for the route, the mileage, hours of operation, and operating costs for the route.

The technical report *2017 On-Road Mobile Source Annual, Summer Weekday and Winter Weekday Emissions Inventories: El Paso County* (TTI, August 2019) describes development of 2017 analysis year El Paso MOVES2014a-based actual on-road inventories, which were the basis for these MOVES runs, with respect to MOVES modeling procedures and MOVES input data. MOVES modeling set-ups and input data combinations are described starting on Page 33 of the report, in the section "Estimation of Seasonal Weekday Emission Rates". Tables 22 through 33 and surrounding text contain the details. The MOVES modeling part of the process and the local/default input data combinations as described (Table 24) were used, but for the CMAQ analysis years 2023 and 2025 (versus 2017 inventory year). In particular, for summer season the actual fuel formulation RVP level, sulfur content, and benzene content values were modified to reflect "expected" future year values in place of the summer 2017, local survey-based actual average RVP and sulfur and benzene level values (i.e., to consistency with state and federal standards). (Appropriate MOVES winter default formulations were used in absence of local, winter survey data.) The age distributions and AVFT input data from the 2017 analysis were used (although still based on the mid-year 2014 TxDMV vehicle registrations data, which is currently still "latest available").

Transit passenger characteristics were derived from the American Public Transportation Association report *A Profile of Public Transportation Passenger Demographics and Travel Characteristics Reported in On-Board Surveys* published in May 2007.

Analysis Methods

TTI staff used an analysis method provided in the August 2008 version of the MOSERs Guide, equation 3.2 - *System/Service Operational Improvements*. The detailed equation is provided below in Strategy Equation.

Stated in words, the equation measures the reduction in start emissions and running exhaust emissions from a change in mode during the operating period and subtracting any additional emissions from the transit vehicles. The benefit is derived through attracting single occupant passenger vehicle drivers to utilize transit as their mode of travel.

The analysis year used is 2023. *For planning purposes, the emissions benefit of a static program will decline over time.*

Assumptions in the MOVES2014a output for the project included:

- Output created for VOC, CO, NOx, and PM-10
- Light-duty passenger vehicles and light-duty passenger trucks (SUVs) vehicle types, gasoline and diesel-fueled, are included according to a projected regional VMT fleet mix (Source Type ID 21, 31)
- The project is assumed to be implemented in the analysis; therefore, no transit vehicle emissions are included in the analysis.
- Considering the project area and the type of trips reduced through the strategy, primarily, freeway commuting, emissions on Road Type 4, urban restricted access was used.
- Average speed on IH-10 during RTS operating hours (peak and off-peak) is assumed 30 mph (Speed bin 7).
- The analysis period is AM peak hours of 6:00-9:00 a.m., off-peak daytime hours from 9:00 a.m.-3:00 p.m. and PM peak hours of 3:00-8:00 p.m. on a winter weekday for CO; the same periods on a summer weekday for NOx, VOC, and PM-10.
- The vehicle trips reduced (VT_R) and vehicle-miles travelled reduced (VMT_R) were distributed proportionally across the 14 hours of model analysis and by vehicle type and fuel type in line with the vehicle fleet mix in the El Paso region.

TTI staff reviewed the project information to determine values for the individual variables in the MOSERs equation. The MOSERS Guide encourages planners to make conservative, justifiable assumptions about projects.

- Based on ridership data provided by Sun Metro and factoring in ridership growth, an average daily ridership of 3,600 was assumed.
- APTA ridership survey reports show 52% of transit passengers to be commuting. The RTS project focuses on capturing new commute traffic, so 75% of riders are assumed to be traveling to work and back totaling 2,700 per day.
- The analysis assumes 35% of these commute passengers are former single occupant vehicle (SOV) drivers. This translates to 26.25% of all passengers. This should be considered optimistic. The APTA survey report showed 14.3% of transit roadway passengers would drive alone as an alternative if no transit service was available. However, this new service actively seeks SOV commuters.
- An average trip length of 12.6 miles was computed based on data provided by Sun Metro. The trip lengths were distributed evenly in the reduced VMT.

The final estimated emission reductions are presented in kilograms per day (kg/day) in accordance to CMAQ project reporting requirements.

Strategy Equation

Note: Due to the extensiveness of the MOVES model output data and to help presentation of results, the individual start rates and emission rates per distance ($\mathbf{TEF}_{AUTO}$ and $\mathbf{EF}_{B}$) per vehicle type computed are not presented but are available for review if needed. Also, the project is assumed implemented by phase 2 thus transit vehicle emissions (parts C and D) are not included in this analysis.

3.2 System/Service Operational Improvements

Daily Emission Reduction (for each pollutant) = A + B

$$A = VT_{R} * TEF_{AUTO}$$

Reduction in auto start emissions from trips reduced

$$B = VMT_{R} * EF_{B}$$

Reduction in auto running exhaust emissions from VMT reductions

Where

$VT_{R} = N_{TR} * F_{T, SOV}$

Number of new transit riders multiplied by the percentage of riders shifting from single-occupant auto use

$VMT_{R} = VT_{R} * TL_{W}$

Number of vehicle trips reduced multiplied by the average auto trip length

Final unit of measure: grams/day
Source: Texas A&M Transportation Institute

Variables:

Variables:	**EF_{B}:**	Speed-based running exhaust emission factor for affected roadway before implementation (NO_x, VOC, or CO) (grams/mile)
	$F_{T, SOV}$:	Percentage of people using a transit vehicle that previously were vehicle drivers (decimal)
	N_{TR}:	New transit ridership
	TEF_{AUTO}:	Auto trip-end emission factor (NO_x, VOC, or CO) (grams/trip)
	TL_{W}:	Average auto trip length (miles)
	VMT_{R}:	Reduction in daily automobile VMT
	VT_{R}:	Reduction in number of daily automobile vehicle trips

Analysis

VT_R = (3,600 * 2) * 0.52 = 3,744 trips/day

Number of transit riders multiplied by 2 multiplied by the percentage of riders shifting from single-occupant auto use

VMT_R = 3,744 * 12.6 = 47,174 vehicle-miles/day

Number of vehicle trips reduced multiplied by the average auto trip length

Summary of Results

The emissions analysis result for the project is shown in Table 1. There are significant daily emissions benefits for all four pollutants. The results indicate an estimated air quality benefit from the Montana RTS Phase 2 operational assistance project.

Table 1. Montana RTS Operational Assistance – Phase 2 Emission Reductions

Pollutant	Emissions Reduction (kg/day)
CO	99.211
NOx	6.635
VOC	4.688
PM_{10}	2.513

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Emission Reduction Analysis for Sun Metro Proposed CMAQ Project

Montana RTS Operations Assistance Phase 3

March 2020

Prepared for

sunmetro

By

Texas A&M Transportation Institute

Task Summary

The Texas A&M Transportation Institute (TTI) El Paso office was tasked by Sun Metro to perform a mobile source emissions analysis for a proposed project in the El Paso nonattainment area. The transit agency is seeking funding from the Congestion Mitigation/Air Quality Improvement Program (CMAQ).

The project is operational assistance for the third phase of the Rapid Transit Service, BRIO, in the Montana corridor in east-central El Paso region.

Individual Project Analysis

The emissions analysis for the project is presented below. The strategy name is given along with a brief description of the project. Data sources and analysis assumptions are provided. The equation used from the *Texas Guide to Accepted Mobile Source Emission Reduction Strategies* (MOSERs Guide) is given for the strategy along with the variables of the equation and the equation itself. The results are then computed for the strategy equation.

It is recommended that the agency conduct a more detailed emissions study of the project as it develops further. The results presented below are valid for CMAQ program submission, but *this analysis should not be used for conformity purposes*.

Montana RTS Operations Assistance - Phase 3

Sun Metro transit agency is proposing operations assistance for the third phase of the 16.8-mile BRIO line in the Montana corridor in east El Paso region. The RTS line begins at the Five Points Terminal and ends at the future Far East Transfer Center. Twelve buses will operate along the route with 26 stations.

Data Sources

Sun Metro provided several data sources to the TTI team for the original analysis: a map of the proposed route, previous emissions analysis for the route, the mileage, hours of operation, and operating costs for the route.

The technical report *2017 On-Road Mobile Source Annual, Summer Weekday and Winter Weekday Emissions Inventories: El Paso County* (TTI, August 2019) describes development of 2017 analysis year El Paso MOVES2014a-based actual on-road inventories, which were the basis for these MOVES runs, with respect to MOVES modeling procedures and MOVES input data. MOVES modeling set-ups and input data combinations are described starting on Page 33 of the report, in the section "Estimation of Seasonal Weekday Emission Rates". Tables 22 through 33 and surrounding text contain the details. The MOVES modeling part of the process and the local/default input data combinations as described (Table 24) were used, but for the CMAQ analysis years 2023 and 2025 (versus 2017 inventory year). In particular, for summer season the actual fuel formulation RVP level, sulfur content, and benzene content values were modified to reflect "expected" future year values in place of the summer 2017, local survey-based actual average RVP and sulfur and benzene level values (i.e., to consistency with state and federal standards). (Appropriate MOVES winter default formulations were used in absence of local, winter survey data.) The age distributions and AVFT input data from the 2017 analysis were used (although still based on the mid-year 2014 TxDMV vehicle registrations data, which is currently still "latest available").

Transit passenger characteristics were derived from the American Public Transportation Association report *A Profile of Public Transportation Passenger Demographics and Travel Characteristics Reported in On-Board Surveys* published in May 2007.

Analysis Methods

TTI staff used an analysis method provided in the August 2008 version of the MOSERs Guide, equation 3.2 - *System/Service Operational Improvements*. The detailed equation is provided below in Strategy Equation.

Stated in words, the equation measures the reduction in start emissions and running exhaust emissions from a change in mode during the operating period and subtracting any additional emissions from the transit vehicles. The benefit is derived through attracting single occupant passenger vehicle drivers to utilize transit as their mode of travel.

The analysis year used is 2025. *For planning purposes, the emissions benefit of a static program will decline over time.*

Assumptions in the MOVES2014a output for the project included:

- Output created for VOC, CO, NOx, and PM-10
- Light-duty passenger vehicles and light-duty passenger trucks (SUVs) vehicle types, gasoline and diesel-fueled, are included according to a projected regional VMT fleet mix (Source Type ID 21, 31)
- The project is assumed to be implemented in the analysis; therefore, no transit vehicle emissions are included in the analysis.
- Considering the project area and the type of trips reduced through the strategy, primarily, freeway commuting, emissions on Road Type 4, urban restricted access was used.
- Average speed on IH-10 during RTS operating hours (peak and off-peak) is assumed 30 mph (Speed bin 7).
- The analysis period is AM peak hours of 6:00-9:00 a.m., off-peak daytime hours from 9:00 a.m.-3:00 p.m. and PM peak hours of 3:00-8:00 p.m. on a winter weekday for CO; the same periods on a summer weekday for NOx, VOC, and PM-10.
- The vehicle trips reduced (VT_R) and vehicle-miles travelled reduced (VMT_R) were distributed proportionally across the 14 hours of model analysis and by vehicle type and fuel type in line with the vehicle fleet mix in the El Paso region.

TTI staff reviewed the project information to determine values for the individual variables in the MOSERs equation. The MOSERS Guide encourages planners to make conservative, justifiable assumptions about projects.

- Based on ridership data provided by Sun Metro and factoring in ridership growth, an average daily ridership of 3,700 was assumed.
- APTA ridership survey reports show 52% of transit passengers to be commuting. The RTS project focuses on capturing new commute traffic, so 75% of riders are assumed to be traveling to work and back totaling 2,775 per day.
- The analysis assumes 35% of these commute passengers are former single occupant vehicle (SOV) drivers. This translates to 26.25% of all passengers. This should be considered optimistic. The APTA survey report showed 14.3% of transit roadway passengers would drive alone as an alternative if no transit service was available. However, this new service actively seeks SOV commuters.
- An average trip length of 12.6 miles was computed based on data provided by Sun Metro. The trip lengths were distributed evenly in the reduced VMT.

The final estimated emission reductions are presented in kilograms per day (kg/day) in accordance to CMAQ project reporting requirements.

Strategy Equation

Note: Due to the extensiveness of the MOVES model output data and to help presentation of results, the individual start rates and emission rates per distance ($\mathbf{TEF}_{\boldsymbol{AUTO}}$ and $\mathbf{EF}_{\boldsymbol{B}}$) per vehicle type computed are not presented but are available for review if needed. Also, the project is assumed implemented by phase 3 thus transit vehicle emissions (parts C and D) are not included in this analysis.

3.2 System/Service Operational Improvements

Daily Emission Reduction (for each pollutant) = A + B

$$A = VT_R * TEF_{AUTO}$$

Reduction in auto start emissions from trips reduced

$$B = VMT_R * EF_B$$

Reduction in auto running exhaust emissions from VMT reductions

Where

$VT_R = N_{TR} * F_{T, SOV}$

Number of new transit riders multiplied by the percentage of riders shifting from single-occupant auto use

$VMT_R = VT_R * TL_W$

Number of vehicle trips reduced multiplied by the average auto trip length

Final unit of measure: grams/day
Source: Texas A&M Transportation Institute

Variables:

EF_B:	Speed-based running exhaust emission factor for affected roadway before implementation (NO_x, VOC, or CO) (grams/mile)
$F_{T, SOV}$:	Percentage of people using a transit vehicle that previously were vehicle drivers (decimal)
N_{TR}:	New transit ridership
TEF_{AUTO}:	Auto trip-end emission factor (NO_x, VOC, or CO) (grams/trip)
TL_W:	Average auto trip length (miles)
VMT_R:	Reduction in daily automobile VMT
VT_R:	Reduction in number of daily automobile vehicle trips

Analysis

VT_R = (3,700 * 2) * 0.52 = 3,848 trips/day

Number of transit riders multiplied by 2 multiplied by the percentage of riders shifting from single-occupant auto use

VMT_R = 3,848 * 12.6 = 48,485 vehicle-miles/day

Number of vehicle trips reduced multiplied by the average auto trip length

Summary of Results

The emissions analysis result for the project is shown in Table 1. There are significant, continued daily emissions benefits for all four pollutants. The results indicate an estimated air quality benefit from the Montana RTS Phase 3 operational assistance project.

Table 1. Montana RTS Operational Assistance – Phase 3 Emission Reductions

Pollutant	Emissions Reduction (kg/day)
CO	90.721
NOx	5.599
VOC	4.504
PM_{10}	2.569

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