Basics of the Texas Guide to Accepted Mobile Source Emission Reduction Strategies (MOSERS)

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TWG Meeting

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Goal

Participants will better understand:

- MOSERS methodologies basics
- Types of emission reduction strategies
- Basics on activities & emission rates
- Difference of benefits in SIP, conformity, and CMAQ
- Hands-on exercise on a few strategies

Outline

MOSERS Background

Introduction to Emissions, Emission Rates, and Activity

Update to MOSERS

MOSERS Application in SIP, Conformity and CMAQ

Class Room Exercise

MOSERS Background

Hand calculations

- Simple equations
- Requires assumptions
- Less time and data needed

Models

- More accurate
- Complex and data intensive
- Requires skills such as software programs

MOSERS Background Cont'd

MOSERS First Edition 2003

- Reviewed agencies needed consistencies
- Uniformity in emission reduction strategies

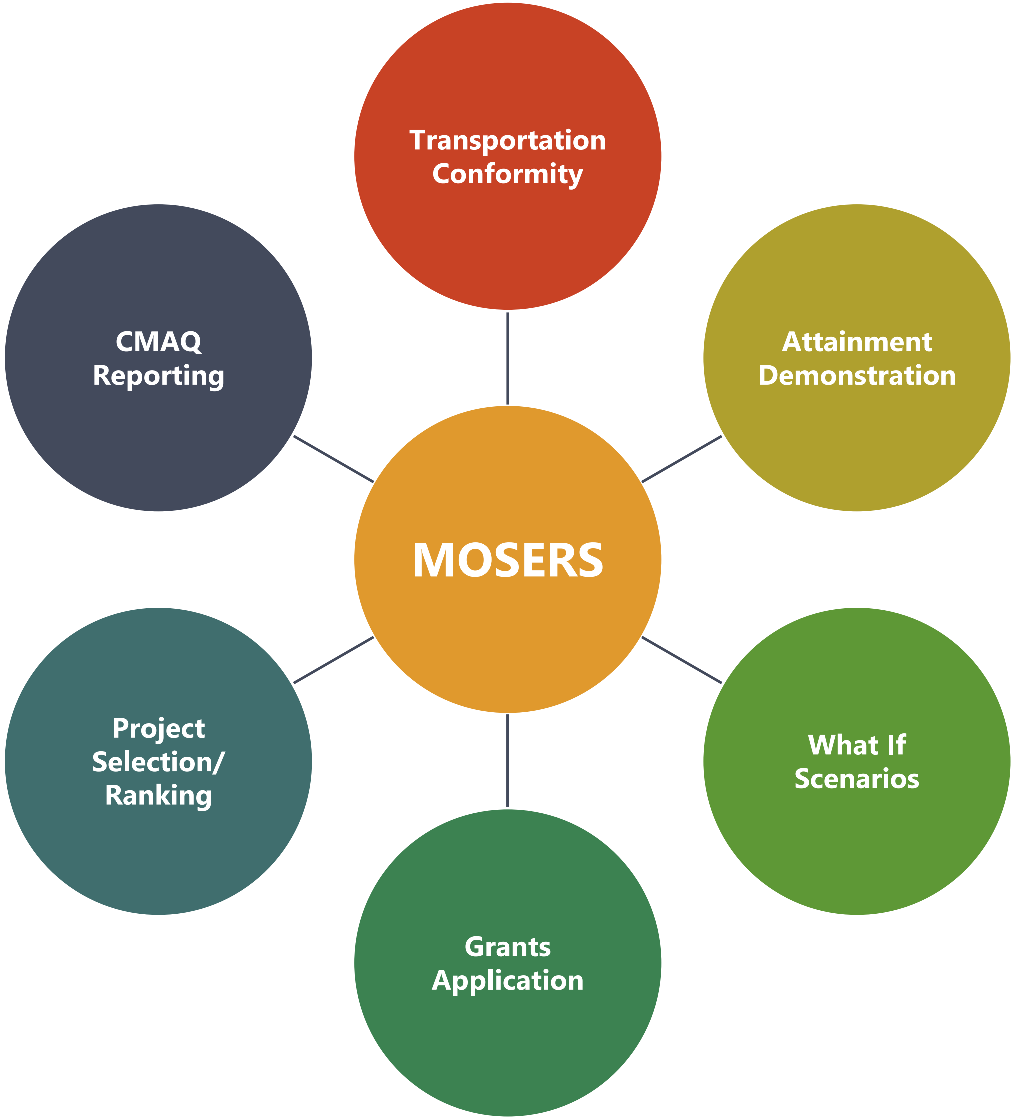
MOSERS Second Edition 2007

- Modifications to the equations as recommended by users
- Added new strategies

MOSERS Third Edition 2017

- Uniformity in **activity** estimation
- Refinement of equations
- Adding new strategies

MOSERS Applications



Transportation Emission Reduction Strategies

Transportation Control Measure (TCM)

- Commitments identified in the SIP & used in AQ Conformity analysis

Voluntary Mobile Emission Reduction Measures (VMEP)

- Commitments identified in the SIP & can be used in AQ Conformity analysis

Transportation Emission Reduction Measures (TERMS)

- Utilized in AQ Conformity analysis as additional credits

Weight of Evidence (WOE)

- May be documented but not credited in the SIP

Example TCMs, TERMS, & VMEPs

Transportation Control Measures (TCM)	Transportation Emission Reduction Measures (TERMS)	Voluntary Mobile Emission Reduction Programs (VMEP)
• Intersection improvements • Bicycle/pedestrian facilities • HOV lanes • Rail • Grade separations • Park-n-Ride • Vanpools	• Intelligent transportation systems • Traffic signal improvements	• Employee trip reduction program • Clean vehicle program • Locally enforced idling restriction • Diesel idling reduction program

Modeled vs Non-Modeled

Modeled

- High occupancy vehicle (HOV) lanes
- Grade separations
- Transit

Non-Modeled

- Bike-Ped
- Signal improvements
- Intersection improvements

Introduction to Emissions, Emission Rates and Activity

Emissions Estimation

Calculated as mass/time (lbs/day, kg/day, tons/year, etc.)

EMISSIONS = ACTIVITY × EMISSION RATES

Where:

- Activity can be VMT, number of starts, idling hours, fuel consumed, etc.
- Emission rates can be function of fuel, speed, duration, etc.

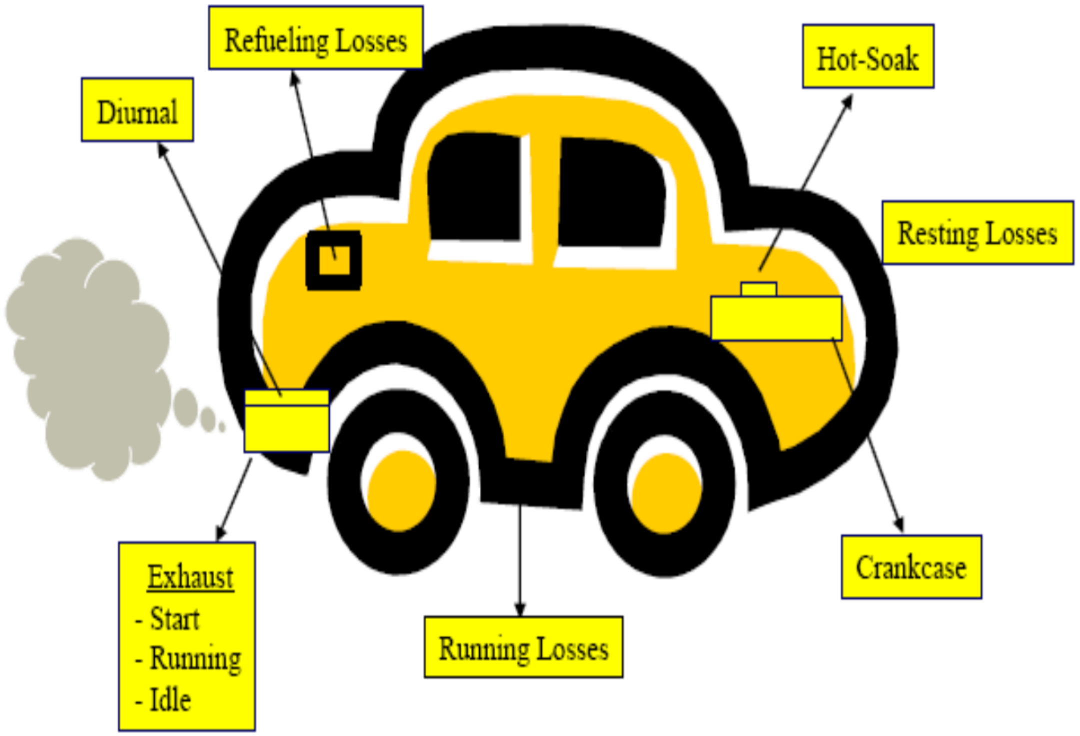
Vehicular Emissions Sources

Emissions occur when vehicle

- Starts
- Idling
- Running
- Parked

Emissions vary

- Fuel
- Vehicle type & age
- Operating speed



Emission Rates Estimation Models

1978
- MOBILE1

1981
- MOBILE2

1984
- MOBILE3

1989
- MOBILE4

1993
- MOBILE5

2002
- MOBILE6

2003
- MOBILE 6.2

2010
- MOVES 2010

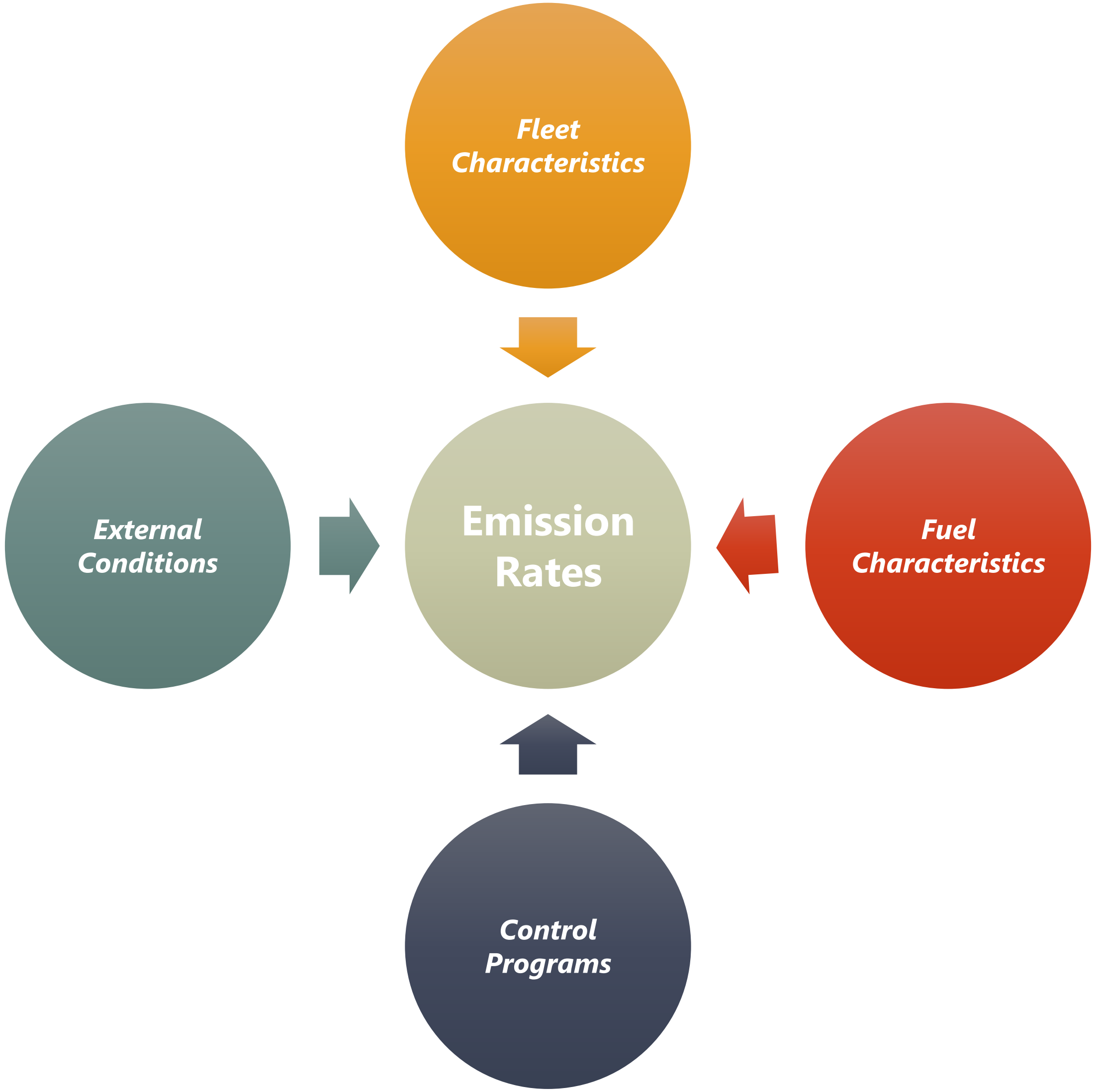
2010
- MOVES 2010a

2013
- MOVES 2010b

2014
- MOVES 2014

2015
- MOVES 2014a

Factors Affecting Emission Rates



Major Sources of Key Input Data

State Air Agency

Fuel properties

State programs

Meteorological info

State DOT and DMV

Vehicle type and age distribution

Fuel/engine fraction

MOVES

MPOs

Vehicle activity (VMT and speed)

Hourly distribution of VMT and speed

EPA & MOVES defaults

VMT distribution by age

Starts per vehicle

Etc.

MOVES Emission Process

Process ID	Emission Process	Rates/Distance	Rates/Vehicle	Rate/Profile
1	Running Exhaust	X		
2	Start Exhaust		X	
9	Brakewear	X		
10	Tirewear	X		
11	Evap Permeation	X	X	X
12	Evap Fuel Vapor Venting	X		X
13	Evap Fuel Leaks	X	X	X
15	Crankcase Running Exhaust	X		
16	Crankcase Start Exhaust		X	
17	Crankcase Extended Idle Exhaust		X	
18	Refueling Displacement Vapor Loss	X	X	
19	Refueling Spillage Loss	X	X	
90	Extended Idle Exhaust		X	
91	Auxiliary Power Unit		X	

MOVES Roadway Type

Rural & Urban Restricted Access

- Freeways/interstate highways
- Toll-ways
- Managed/HOV lanes

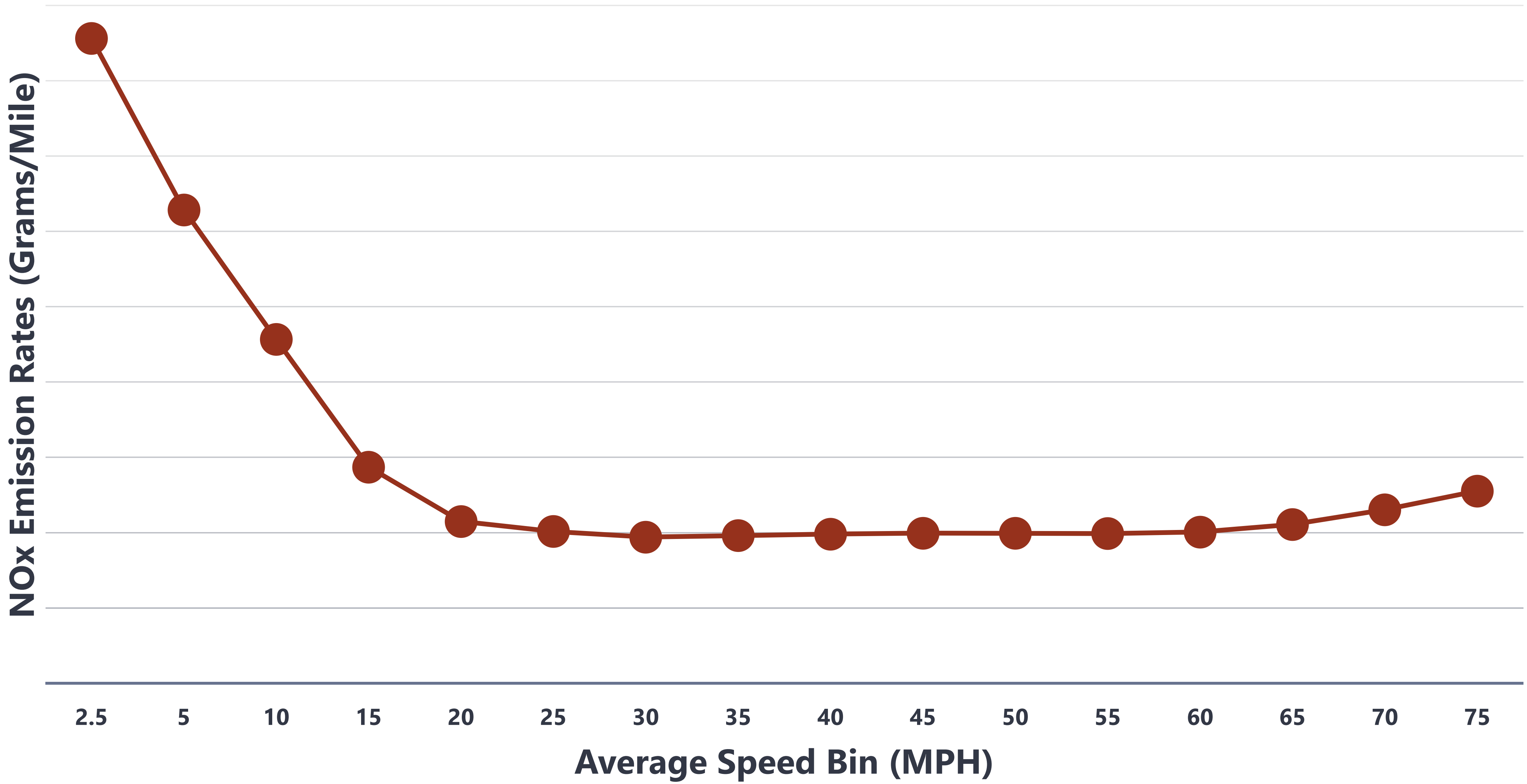
Rural & Urban Unrestricted Access

- Arterials
- Collectors
- Locals
- Ramps

MOVES Vehicle Types

Vehicle Class	Source Type ID	Description
Light Duty	11	MotorCycle
	21	Passenger Car
	31	Passenger Truck: SUV, Pickup Truck, Minivans - Two-Axle/Four-Tire Single Unit
	32	Light Commercial Trucks - Two-Axle/Four-Tire Single Unit
Buses & Medium-Duty	41	Intercity Buses
	42	Transit Buses
	43	School Buses
	52	Single-Unit Short-Haul Trucks
	53	Single-Unit Long-Haul Trucks
	54	Single- Unit Motor Homes
Heavy Duty	51	Refuse Trucks
	61	Combination Short-Haul Trucks
	62	Combination Long-Haul Trucks

Emission Rates by Speed (Light Duty Gasoline)



Additional Notes for Emission Rates

Emission models are time consuming & data intensive

Not necessary to run models to calculate emissions for all strategies

Preference for local data where available

Emission rates requires post processing depending on the strategy

Emission rates, where to get them

- MPO
- TCEQ
- TxDOT/TTI

How Are The Rates Used?

Emission Outputs

Rates per Distance

- Running exhaust
- Evaporative permeation
- Evaporative fuel vapor venting
- Evaporative leaks
- Crankcase running

Rate per Activity

- Start Exhaust
- Evaporative permeation
- Evaporative fuel leaks
- Crankcase start
- Extended idle exhaust
- Evaporative fuel vapor venting

Activity Information

- Link-based speed and VMT
- Number of starts in each zone
- Number of ends in each zone
- Hours of trucks idling in each zone

Vehicle Activity

X

Emission Rates

Link, Zone, and Regional Emissions

Activity Information Needed for MOSERS

Depends on the strategy

Most common

- VMT (Volume * Length of the Roadway)
- Average hourly speed
- Fuel consumed
- No. of starts
- Idling hours
- Trip length
- Vehicle population

Activity Sources

Activity Type	Data Sources
Vehicle Miles of Travel	Travel demand & micro-simulation model, HPMS
Volume	Travel demand & micro-simulation model, traffic counts, traffic studies
Speed	Travel demand & micro-simulation model, NPMRDS, other data sources
Trip Length	Travel model (regional specific- trip purpose), NHTS
Vehicle Population	TxDOT DMV, other proprietary data sources
Starts	EPA models, other peer reviewed studies and models
Idling Hours	EPA models, fleet management databases, other peer reviewed studies and models
Fuel Consumed	EPA models, fleet management databases, other peer reviewed studies and models

Additional Notes for Vehicle Activity

Activity estimation using models is also time consuming & data intensive

Not necessary to run models to calculate activity for all strategies

Preference for local data where available

Activity is crucial and has many variables VMT, volume, speed, starts, hours. etc.

Vehicle activity, where to get it

- MPO
- TxDOT/TTI
- Other Sources

The Texas Guide to Accepted Mobile Source Emission Reduction Strategies (MOSERS)

3rd Edition

2017

Update to the MOSERS

2017 MOSERS Modules

Modules

- Module 1 – Background material
- Module 2 – Strategies and equations
- Module 3 – Spreadsheet tool for activity (new)

Uniformity

- Common estimation methods for transportation emission reduction strategies and required activity parameters (delay, VMT, speed, etc.)

Content

- Based on the most recent information
- Reorganized and condensed - deliver key items for practitioners

Formatting

- A more visual format to improve user experience

2017 MOSERS Module 1

Overview for air quality practitioners

Structure

- The basics
- Overview of transportation conformity
- Air quality modeling
- Mobile source emission reduction strategies
- Utilization of MOSERS
- Methodologies & information sources
- Analytical approaches and tools

1.0 The Basics

This Chapter provides an overview of the main pollutants involved in the relationship between air quality and transportation as well as the standards by which these pollutants are regulated (National Ambient Air Quality Standards [NAAQS]) and an explanation of attainment designations.

1.1 Air Pollutants

The United States Environmental Protection Agency (EPA), in response to the Clean Air Act of 1970 (CAA) and subsequent amendments, established NAAQS for several pollutants that adversely affect human health and welfare. These are termed "criteria pollutants". The EPA, through state or local air quality agencies, monitors these pollutants against NAAQS. The six criteria pollutants are:

- Carbon monoxide (CO)
- Particulate matter (PM)
- Ground Level Ozone (O_3)
- Nitrogen dioxide (NO_2)
- Lead (Pb)
- Sulfur dioxide (SO_2)

Of these six pollutants, transportation is a major contributor to three pollutants: CO, PM, and ground-level ozone. Exposure to these pollutants can cause or exacerbate health problems and even increase mortality rates. Ozone also contributes to what typically experienced as "smog" or haze. CO and PM are directly emitted from motor vehicles. Ground-level ozone is formed through a complex chemical reaction between two pollutants emitted from motor vehicles: hydrocarbons (HC) and oxides of nitrogen (NO_x), in the presence of sunlight. HC and NO_x are called "precursor" pollutants. The following provides a summary of these pollutants.

Table 1 provides a summary of these emissions and their effects on human health and welfare.

Quick Facts

- Ground level ozone is the major pollutant of concern in Texas.
- Ground level ozone concentrations peak in the summertime.

2017 MOSERS Module 2

Strategies grouped

Individual Strategies

- Description
- Application
- Equation
- Variables

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2017 MOSERS Module 2 Cont'd

3.1 Transit/Rideshare Services

Reduce vehicle trips and emissions through increased use of transit, carpooling, or vanpooling.

Description

Employers or groups of employers in activity centers provide transportation service to and from the work site to transit facilities and homes. The services can include subscription buses, midday and park-and-ride shuttles, and guaranteed ride home programs.

Application

Large companies or groups of cooperating businesses.

Equation

$$\text{Daily Emission Reduction} = (A - B) + C \quad \text{(g/day)}$$

$$A = VT_B * TL_B * EF_B$$

Auto running exhaust emissions before strategy implementation

$$B = VT_A * TL_A * EF_A$$

Auto running exhaust emissions after strategy implementation

$$C = (VT_B - VT_A) * TEF_{AUTO}$$

Reduction in start exhaust emissions from reduction in vehicle trips to/from employment center

$$VT_A = N_{VA} * 2 \text{ trips/day}$$
$$VT_B = N_{VB} * 2 \text{ trips/day}$$

Number of vehicles before or after strategy implementation multiplied by two trips per day (round trip)

Variables (unit)		Definitions
EF_A	(g/mi)	Speed-based running exhaust emission factor after implementation (NOx , VOC, or CO)
EF_B	(g/mi)	Speed-based running exhaust emission factor before implementation (NOx, VOC, or CO)
N_{VA}		Number of vehicles after implementation
N_{VB}		Number of vehicles before implementation
TEF_{AUTO}	(g/trip)	Auto trip-end emission factor (NO_x, VOC, and CO)
TL_A	(mi)	Average auto trip length after implementation
TL_B	(mi)	Average auto trip length before implementation
VT_A		Vehicle trips after implementation
VT_B		Vehicle trips before implementation

Source: Texas A&M Transportation Institute

2017 MOSERS Module 3

Excel-based tool

Estimate changes in vehicle activity

Mobile Source Emission Reduction Strategies (MOSERS)

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Strategy	Description
Instructions	Instructions for using the spreadsheet
System Service Expansion	Expansion of Transit System Service Both Buses and Rail
System Operational Improvement	Operational Improvement of Transit System Both Buses and Rail
HOV Facilities	Containing HOV Lanes on Controlled Access Facilities
Trip Reduction Program	Reducing Commute Trips Made by Employees
Traffic Signalization - Coordinated Signals	Traffic Signalization for the Coordinated Signals Along the Corridors
Traffic Signalization - New Signal	Adding a New Signal at the Intersection
Traffic Signalization - Individual Signals	Traffic Signalization for the Individual Signals
Intelligent Transportation	Information Technologies to the Effective Management of a Traffic
Railroad Grade Separation	Converting Railway Crossing Intersection to a Grade Separation Facility
Extended Vehicle Idling	Reducing Extended Vehicle Idling at Construction and Operation of drive-Through Facilities Along with Transit and Delivery Trucks
Clean Vehicle Program	Converting light-duty vehicles, buses, and heavy-duty delivery trucks to natural gas and building a fleet of lower emission vehicles

2017 MOSERS Module 3 Cont'd

Mobile Source Emission Reduction Strategies (MOSERS)

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Project Description:

Scenario Year: 2015

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MOSERS Strategy 5.1 - Traffic Signalization - New Signal

Open Strategy Document

Inputs	Clear Inputs		
Area Type	Urban		
Facility Type - Subject Approaches	Principal Arterials		input the facility type of major street with more traffic, or more lanes
Total Number of Lanes - Subject Approaches	1		
Facility Type - Conflict Approaches	Major Collector		input the facility type of minor street with less traffic, or fewer lanes
Total Number of Lanes - Conflict Approaches	1		
Peak Hour Volume - Subject Approaches (Both directions)	1,015	veh/hour	Default Peak Period Hourly Volume
Peak Hour Volume - Conflict Approaches (Both directions)	656	veh/hour	
Annual Average Daily Traffic - Subject Approaches (Both directions)	15,000	veh/d	
Annual Average Daily Traffic - Conflict Approaches (Both directions)	9,696	veh/d	
Proposed Intersection Signal Cycle Length	100	sec	

Hide Default and Calculated Data

Default Data	Restore Defaults		
Peak Hour Intersection Delay Before Improvement	50	sec/veh	The number is presumed and could be changed based on local data
Off-Peak Hour Intersection Delay Before Improvement	25	sec/veh	The number is presumed and could be changed based on local data
Peak Hour in a Day	6	Hours	The number of peak hours is presumed and could be changed based on local data
Off-Peak Hour in a Day	18	Hours	24 - peak hours
Effective Green to Cycle Length Ratio of Subject Approaches	0.508		Reference: MOVES2014 Statewide Non-Link On-Road Emissions Inventories for 2006, 2012, and 2018
Effective Green to Cycle Length Ratio of Conflict Approaches	0.478		Reference: MOVES2014 Statewide Non-Link On-Road Emissions Inventories for 2006, 2012, and 2018
Incremental Delay Upstearm Filtering or Metering Adjustment Factor for Isolated Intersection	1		Reference: HCM 2010
Incremental Delay Adjustment for the Actuated Control	0.5		Reference: HCM 2010
Capacity at Intersection - Subject Approaches (Both Directions)	1,506	veh/hr/ln	Reference: MOVES2014 Statewide Non-Link On-Road Emissions Inventories for 2006, 2012, and 2018
Capacity at Intersection - Conflict Approaches (Both Directions)	1,416	veh/hr/ln	Reference: MOVES2014 Statewide Non-Link On-Road Emissions Inventories for 2006, 2012, and 2018

5.6 Traffic Signalization – New Signal

Reduce carbon monoxide (CO) and hydrocarbon (HC) emissions by decreasing vehicular stops and idling, which would in turn reduce travel times and traffic delays.

Project Description

Traffic signalization increases the efficiency of traffic flow at intersections by improving interconnection and coordination of signals, leading to reductions in travel times, delay, and stop-and-go driving. Traffic signalization can be as simple as updating equipment and/or software or improving the timing plan.

Methodology Assumption

The approach does assume the default auto trip length equal to transit corridor length. Using local data if available will make the results more accurate.

Inputs

The approach requires user-specific local inputs listed in Table 5.6.1.

Table 5.6.1 Traffic Signalization – New Signal Project Specific Inputs

Input	Default Values	Input Guidance
Area Type		• Input the area type
Facility Type - Street 1		• Input the roadway type of approach 1
Total Number of Lanes - Street 1		• Input the number of lanes of approach 1
Facility Type - Street		

2017 MOSERS Module 3 Features

HCM Equations

Inputs

- Preferably Local Data, if Available

Option to Use Defaults

Simplified Calculations

Calculated Data		
Off-Peak Hour Volume - Subject Approaches (Both directions)	495	veh/hour
Off-Peak Hour Volume - Conflict Approaches (Both directions)	320	veh/hour
Critical v/c for the Intersection in Peak Hours	0.67	
Lane Group of Critical v/c in Peak Hours	Subject Approaches	
Effective Green to Cycle Length Ratio of Lane Group with critical v/c in Peak Hours	0.51	
Capacity of Lane Group with Critical v/c in Peak Hours	753	veh/hour
Critical v/c for the Intersection in Off-Peak Hours	0.33	
Lane Group of Critical v/c in Off-Peak Hours	Subject Approaches	
Effective Green to Cycle Length Ratio of Lane Group with Critical v/c in Off-Peak Hours	0.51	
Capacity of Lane Group with Critical v/c in Off-Peak Hours	753	veh/hour
Peak Hour Intersection Delay After Improvement	23.64	sec/veh
Off-Peak Hour Intersection Delay After Improvement	15.93	sec/veh

Output Data		
Average Daily Volume for the Intersection During Peak Hours ($V_{D,P}$)	10,031	veh/d
Average Daily Volume for the Intersection During Off-Peak Hours ($V_{D,OP}$)	14,665	veh/d
Average Vehicle Delay at Intersection before Implementation during Peak Hours ($D_{B,P}$)	0.0139	hour
Average Vehicle Delay at Intersection before Implementation during Off-Peak Hours ($D_{B,OP}$)	0.0069	hour
Average Vehicle Delay at Intersection after Implementation during Peak Hours ($D_{A,P}$)	0.0066	hour
Average Vehicle Delay at Intersection after Implementation during Peak Hours ($D_{A,OP}$)	0.0044	hour

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MOSERS Application in SIP, Conformity and CMAQ

MOSERS Applied in SIP, Conformity, & CMAQ

Emission benefits may differ for same year

Different assumptions & inputs

- Affected by start date of the analysis

SIP

- Emission benefits for future years (attainment demonstration)

Conformity

- Emission benefits for current, future, and past years (depends of MVEB year)

CMAQ

- Reports submitted for completed projects (retrospective)

Project Life

Estimating Cost-Effectiveness

- Grant application
- Project Selection
- CMAQ Funding

Emission Benefits Not Perpetual

Useful Life of the Project

Project Life Cont’d

Cost-effectiveness = Amount of Emissions Eliminated Per Dollar

Cost Effectiveness Calculation Inputs

- Funding dollars
- Activity (before and after)
- Emission Rates (before and after)

Cost-Effectiveness = (CRF * Funding) / Emissions

Capital Recovery Factor (CRF) = $(1 + i)^n (i)/(1 + i)^n – 1$

where I = discount rate, and n = project life

Project Life Cont'd

Project Type	States						FHWA
	AZ	TX	CA	OH, KY & IN	NC	CO	
New Bus	12		12	5-12	12	12	12
Replacement of old buses			5		5		4
New Light Rail	20	20		20			20
Diesel Retrofits	5			8-10	5		
Anti-idling	5						
Truck Stop electrification	5			10	10		10
Alternative Fuel and Vehicles				5			
Auxiliary power units	5						
Additional turning lanes	20						
Roundabouts	20						
Electric Vehicles	5						
Park and Ride	20	20	20	12	20		12
Ride Share	1						1-2
Signal Co-ordination and other signal improvements	5	3		10	10	3	10
Intelligent Transportation Systems	5	10-12					

Class Room Exercise

Overview

- How to use MOSERS equations
- Two hands-on exercise
  - Coordinated signals
  - Vehicle replacement
- Module-3 demonstration

Traffic Flow Improvements

Intersection signal	Optimization, interconnection, and synchronization
Intersection Improvement	Adding exclusive LT/RT lanes, roundabout in place of 4-way stops
Variable message signs/Dynamic message signs	Inform user about roadway conditions
ITS operation	511, 711 systems highway Rescue/Assistance/Service Patrol, Surveillance System/Devices, Incident Management Center
Adding lanes/Increasing capacity	To remove bottle neck
HOV	To reduce SOV utilization

Coordinated Signals

Improved traffic flow

Implemented on major arterials and large capacity roadways

Coordinated Signals Equation

Daily Emission Reduction = A + B (g/day)

$$A = V_{D,P} * (EF_{B,P} - EF_{A,P}) * L$$

Change in running exhaust emissions from improved traffic flow during the peak period

$$B = V_{D,OP} * (EF_{B,OP} - EF_{A,OP}) * L$$

Change in running exhaust emissions from improved traffic flow during the off-peak period

Equation
Daily Emission Reduction = A + B (g/day)
For corridors:
$A = V_{D,P} * (EF_{B,P} - EF_{A,P}) * L$
Change in running exhaust emissions from improved traffic flow during the peak period
$B = V_{D,OP} * (EF_{B,OP} - EF_{A,OP}) * L$
Change in running exhaust emissions from improved traffic flow during the off-peak period
For individual intersection or grade separation:
$A = (D_B - D_A) * EF_I * V_{D,P}$
Change in idling emissions from reduced vehicle delay times during the peak period
$B = (D_B - D_A) * EF_I * V_{D,OP}$
Change in idling emissions from reduced vehicle delay times during the off-peak period

Coordinated Signals Equation

$EF_{A, OP}$	(g/mi)	**Speed-based running exhaust emission factor during off-peak hours in affected corridor after implementation (NO_x , VOC, or CO)**
$EF_{A, P}$	(g/mi)	Speed-based running exhaust emission factor during peak hours in affected corridor after implementation (NO_x, VOC, or CO)
$EF_{B, OP}$	(g/mi)	Speed-based running exhaust emission factor during off-peak hours in affected corridor before implementation (NO_x, VOC, or CO)
$EF_{B, P}$	(g/trip)	Speed-based running exhaust emission factor during peak hours in affected corridor before implementation (NO_x, VOC, or CO)
EF_I	(g/hr)	Idling emission factor (NO_x, VOC, or CO)
L	(mi)	Length of corridor affected by signalization project
$V_{D, OP}$		Average daily volume for the corridor during off-peak hours
$V_{D, P}$		Average daily volume for the corridor during peak hours

Class Exercise 1

City A is planning on retiming signals on one of their principal arterial corridors. The project will be completed in June 2018.

Calculate NOx emission benefits using following information.

AADT = 30,000
Corridor Length = 4 miles
Number of Signals = 4
Peak Hourly Travel Mix = 6.77%
Hours in Peak Period = 6
Before Implementation
- Peak Hour Speed = 17 mph
- Off-peak Hour Speed = 41 mph

After Implementation
- Peak Hour Speed = 18 mph
- Off-peak Hour Speed = 42 mph

Class Exercise 1: Equation

$$\text{Emission (g/day)} = A + B$$

$$A = V_{D,\,P} * (EF_{B,\,P} - EF_{A,\,P}) * L$$

$$B = V_{D,\,OP} * (EF_{B,\,OP} - EF_{A,\,OP}) * L$$

Class Exercise 1: Step 1

Calculate peak hour volume

$V_{D,P}$ = AADT * Peak Hour Mix * Hours in Peak Period

$V_{D,P} = 30{,}000 * 0.0677 * 6$

$V_{D,P} = 12{,}186$

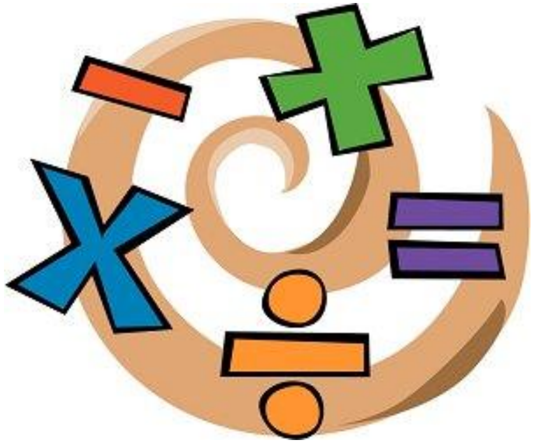
Class Exercise 1: Step 2

Calculate off-peak hour volume

$V_{D,\,OP}$ = AADT – Peak Hour Volume

$V_{D,\,OP} = 30{,}000 - 12{,}186$

$V_{D,\,OP} = 17{,}814$



Class Exercise 1: Step 3

Look-up NOx emission rates

$EF_{B,\ P}$ @ 17 mph=0.464

$EF_{A,\ P}$ @ 18 mph=0.457

$EF_{B,\ OP}$ @ 41 mph=0.356

$EF_{A,\ OP}$ @ 42 mph=0.355

Average Speed (mph)	NOX (g/mile)
2.5	1.370
3	1.176
4	0.933
5	0.793
6	0.715
7	0.660
8	0.618
9	0.586
10	0.560
11	0.539
12	0.521
13	0.507
14	0.494
15	0.483
16	0.473
17	0.464
18	0.457
19	0.450
20	0.443
21	0.436
22	0.430
23	0.424
24	0.418
25	0.413
26	0.407
27	0.402
28	0.397
29	0.392
30	0.388
31	0.382
32	0.377
33	0.372
34	0.368
35	0.363
36	0.362
37	0.360
38	0.359
39	0.358
40	0.357
41	0.356
42	0.355
43	0.355
44	0.354
45	0.353

Class Exercise 1: Step 4

Emission Total NOx Emission Benefits

A = 12,186*(0.464 – 0.457) * 4

B = 17,814* (0.356 – 0.355) * 4

Emission (g/day) = 341.2 + 71.3

Emission = 413 g/day

Demonstration of Module 3

Mobile Source Emission Reduction Strategies (MOSERS)

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Project Description:

Scenario Year: 2016

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MOSERS Strategy 5.1 - Traffic Signalization - For Corridors

Inputs	Clear Inputs	
Area Type	Urban	
Facility Type	Principal Arterials	
Length of Corridor Affected by Signal Coordination Project	4	Miles
Existing Number of Signalized Intersections along the Corridor	4	
Existing Number of Through Lanes along the Corridor (One Direction)	2	
Annual Average Daily Traffic (Both Directions)	30,000	Veh/d
Average Hourly Volume During Peak Period (Both Directions)	2,031	Veh/h
Posted Speed Limit	45	mph
Existing Average Corridor Travel Time During Peak Period (One Direction)	14	Minutes
Existing Average Cycle Length along the Corridor	60	Seconds

Open Strategy Documentation

If there is no hourly data available, leave the average hourly peak hour volume blank and CLICK the Button below to use default values

Default Hourly Volume during Peak Period

Unhide Default and Calculated Data

Activity Output Data		
Length of Corridor Affected by Signalization Project (L) (Miles)	4	Miles
Average Daily Volume for the Corridor During Peak Hours ($V_{D, P}$)	12,185	Veh/d
Average Daily Volume for the Corridor During Off-Peak Hours ($V_{D, OP}$)	17,815	Veh/d
Average Speed during Peak Hours in Affected Corridor before Implementation ($v_{B, P}$)	17	mph
Average Speed during Peak Hours in Affected Corridor after Implementation ($v_{A, P}$)	18	mph
Average Speed during Off-Peak Hours in Affected Corridor before Implementation ($v_{B, OP}$)	41	mph
Average Speed during Off-Peak Hours in Affected Corridor after Implementation ($v_{A, OP}$)	42	mph

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Discussions on Exercise-1

Vehicle Repower, Retrofit, and Replacement

Replacement to Alternative Fuels Vehicles

Repower Alternative Fuels Engines

Vehicle Replacement

Lower emission vehicles

Implemented at both public and private sectors

Vehicle Replacement Equation

Daily Emission Reduction = VMT_{REP} * (EF_B – EF_A) (g/day)

EF_A	**(g/ mi)**	**Speed-based running exhaust emission factor after replacement (NO_x , VOC, or CO)**
EF_B	(g/ mi)	Speed-based running exhaust emission factor before replacement (NO_x, VOC, or CO)
VMT REP		VMT of the vehicle to be replaced

graph Styles Editing

16.1 Clean Vehicle Program

Reduce vehicle emissions through new vehicle technology.

Description

Public funding can be committed toward the differential cost of replacing vehicles with lower emissions vehicles. The program aids in converting light-duty vehicles, transit buses, school buses, and heavy-duty delivery trucks to natural gas and building a fleet of lower emission vehicles. Programs are open to all public fleets, transit agencies, and private companies.

Application

Cities, agencies, and employers with a vehicle fleet.

Equation

Daily Emission Reduction = VMT_{REP} * (EF_B – EF_A) (g/day)

Average daily VMT of the replaced vehicle multiplied by the change in pre-replacement and post-replacement composite emission factors

Variables (unit)		Definitions
EF_A	(g/mi)	Speed-based running exhaust emission factor after replacement (NO_x , VOC, or CO)
EF_B	(g/mi)	Speed-based running exhaust emission factor before replacement (NO_x, VOC, or CO)
VMT_{REP}		VMT of the vehicle to be replaced

Source: CalTrans/ CARB

Class Exercise 2

City B proposes to purchase 3 refuse hauler trucks equipped with CNG engines to replace 3 diesel vehicles. Calculate daily NOx emission benefits and cost-effectiveness ($/lb, $/ton) using following inputs

Funding Dollars = $60,000

Effectiveness Period Life: 10 years

Interest Rate = 3%

Annual Miles Traveled per vehicle= 210,000

Emission Rates for Diesel Vehicles (before) = 5.8 gms/mile

Emission Rates for CNG Vehicles (After) = 3.8 gms/mile

Class Exercise 2: Step 1

Estimate NOx Emissions

NOx Emissions (lbs/year)= VMT_{REP} * (EF_B – EF_A)/454

NOx Emissions (lbs/year)= 210,000 * (5.8 – 3.8)/454

NOx Emissions = 925 lbs/year

For 3 Vehicles NOx Emissions = 2775 lbs/year

NOx Emissions (tons/year)=2775/2000

NOx Emissions = 1.39 tons/year

Class Exercise 2: Step 2

Estimate Capital Recovery Factor (CRF)

$CRF = (1 + i)^{n}(I)/(1 + i)^{n-1}$

$CRF = (1 + 0.03)^{10}(0.03)/(1 + 0.03)^{10-1}$

$CRF = 0.12$

Class Exercise 2: Step 3

- Estimate Cost Effectiveness

Cost Effectiveness ($/lb) = (0.12 * 60,000) / 2775

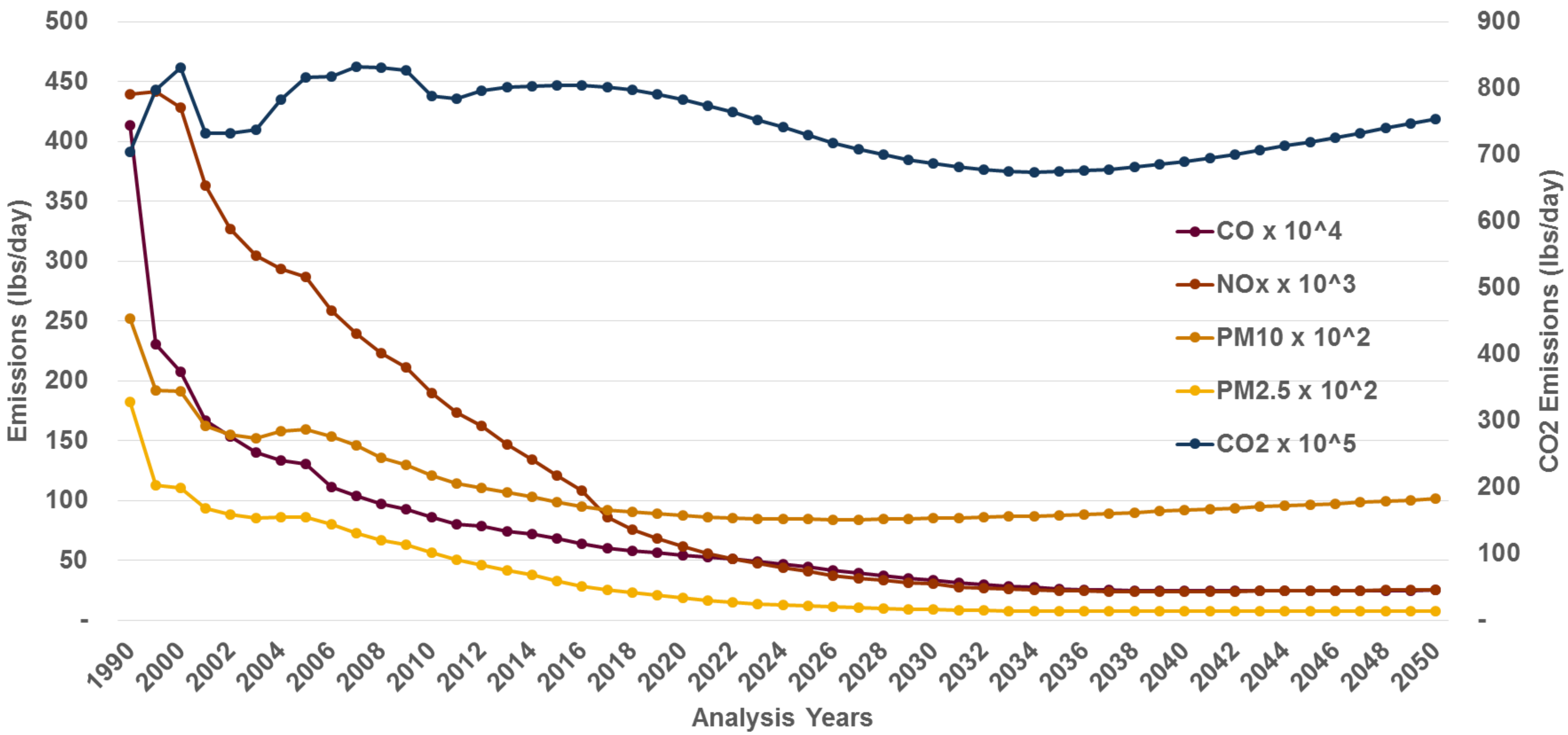
Cost Effectiveness = $2.6 per lb

Cost Effectiveness ($/ton) = 2.6 $/lb * 2000 lb/ton

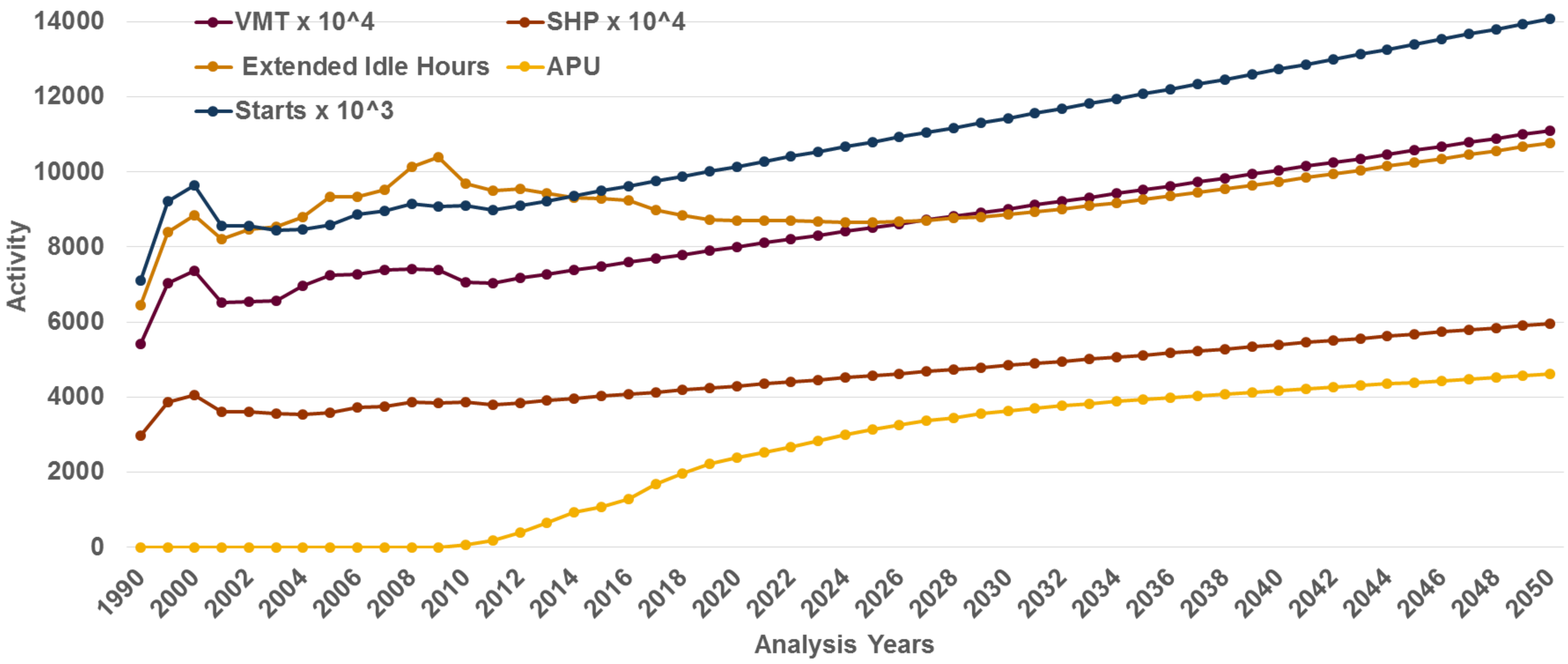
Cost Effectiveness = $5,200 per ton

Discussions on Exercise-2

Emission Trends



Activity Trends



Final Thoughts

- Encourage Texas Practitioners to use MOSERS
- Welcome Suggestions and Recommendations to Improve
- New Information Included When Available
- New Methodologies Will be Added
- Continual Improvement of Content and User Experience

Resources

FHWA

https://www.fhwa.dot.gov/environment/air_quality/cmaq/toolkit/index.cfm,
http://www.fhwa.dot.gov/environment/air_quality/conformity/research/mpe_benefits/ ,
http://www.fhwa.dot.gov/environment/air_quality/conformity/research/transportation_control_measures/tcm3.cfm
https://www.fhwa.dot.gov/environment/air_quality/cmaq/training/
https://www.fhwa.dot.gov/environment/air_quality/cmaq/research/cmaq_cost.cfm
https://www.fhwa.dot.gov/environment/air_quality/cmaq/reference/cost_effectiveness_tables/
https://www.fhwa.dot.gov/environment/air_quality/conformity/methodologies/moves.cfm

TxDOT

http://www.txdot.gov/inside-txdot/division/environmental/compliance-toolkits/air-quality.html

Resources

EPA

https://www.epa.gov/state-and-local-transportation/matrix-epa-guidance-documents-developing-and-quantifying-control,

http://www.epa.gov/otaq/stateresources/transconf/policy/420b14007.pdf,

http://www.epa.gov/otaq/stateresources/transconf/policy/truckidlingguidance.pdf

https://www.epa.gov/state-and-local-transportation/transportation-conformity

http://www.fhwa.dot.gov/environment/air_quality/conformity/research/transportation_control_measures/tcm3.cfm

TCEQ

https://www.tceq.texas.gov/airquality/sip/

Questions

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