

IMPO CMAQ Tool Training

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Topics

- Introduction to the CMAQ Tool
- CMAQ Tool update
- Emission rates update

What is it?

- Emissions calculator for CMAQ funding & reporting
- Estimates reductions for NO_x, VOC, PM_{2.5}, SO₂, CO, GHG

When was it developed?

- 2014 – by Cambridge Systematics, Inc. for IMPO

Why update it?

- Limitations of original tool
 - Years limited to 2015–2025
 - HCM-based delay estimation (Tab 2.2, 2.3a-d, 2.4) → cumbersome, less flexible
- Key updates
 - MOVES5 rates (2025 & 2035)
 - Direct travel time/delay inputs (e.g., Synchro, SIDRA, etc.)
 - Consolidated strategy sections

Signal Synchronization – Previous (2.2)

Signal Synchronization

Data Type

Morning Peak - Inbound

Afternoon Peak - Outbound

Data Type	Morning Peak - Inbound	Afternoon Peak - Outbound
Scenario Year	2030	2030
Length of the signalized corridor (miles)	4	4
Existing Number of Signalized Intersections	8	8
Existing Number of Lanes (one direction)	3	3
Average hourly volume during peak period (one direction)	1000	1000
Truck Percentage (one direction)	3%	3%
Average corridor travel time (one direction) during peak period (minutes)	9	9
Existing Average Cycle Length (seconds)	60	60

CONSTANTS

Data Type

Data Type	Morning Peak - Inbound	Afternoon Peak - Outbound
Hours in Peak Period	4	4
Number of weekdays per year	250	250

SCENARIO YEAR OUTPUTS

Data Type

Data Type	Morning Peak - Inbound	Afternoon Peak - Outbound
Travel Time Savings (min)	0.50	0.50
Travel Time after Improvements	8.50	8.50
Auto VMT (one direction)	3,880	3,880
Truck VMT (one direction)	120	120
Existing Avg Speed (mph)	26.7	26.7
Improved Avg Speed (mph)	28.2	28.2
Reduction in Annual Vehicle Hours of Delay	8,265.3	8,265.3

EMISSIONS

Emission Factors - Existing

Morning Peak - Inbound

Afternoon Peak - Outbound

Emission Factors - Existing	Morning Peak - Inbound	Afternoon Peak - Outbound
Light Duty Emission Factor GHG (gCO2eq/mi)	324.462	324.462
Light Duty Emission Factor PM NOx(g/mi)	0.109	0.109
Light Duty Emission Factor PM (g/mi)	0.004	0.004
Light Duty Emission Factor NOx (g/mi)	0.118	0.118
Light Duty Emission Factor VOC (g/mi)	0.070	0.070
Light Duty Emission Factor SO2 (g/mi)	0.002	0.002
Light Duty Emission Factor CO (g/mi)	1.879	1.879

- Evaluates synchronization along arterial corridors
- Previous** method required inputs:
 - Number of signalized intersections
 - Number of lanes (per direction)
 - Avg. cycle length (seconds), etc.
- Travel time savings estimated using **HCM methods**

Signal Synchronization – Updated Tab (2.2)

Signal Synchronization

CALCULATION INPUTS

Data Type	AM Peak Hour, Peak Direction User-Defined Values	PM Peak Hour, Peak Direction User-Defined Values
Scenario Year	2030	2030
Corridor Length (miles)	4	4
Average Traffic Volume during Peak Hour (one direction)	1000	1000
Percentage of Trucks (one direction)	3%	3%
Average Corridor Travel Time (min) during Peak Hour (peak direction) - before Improvements	9	9
Average Corridor Travel Time (min) during Peak Hour (peak direction) - after Improvements	8.5	8.5

CONSTANTS

Data Type		
Hours in Peak Period	4	4
Number of weekdays per year	250	250

SCENARIO YEAR OUTPUTS

Data Type		
Auto VMT (one direction)	3,880	3,880
Truck VMT (one direction)	120	120
Existing Avg Speed (mph)	26.7	26.7
Improved Avg Speed (mph)	28.2	28.2
Reduction in Annual Vehicle Hours of Delay	8,265.3	8,265.3

EMISSIONS

Emission Factors - Existing	AM Peak Hour, Peak Direction	PM Peak Hour, Peak Direction
Light Duty Emission Factor GHG (gCO2eq/mi)	263.727	263.727
Light Duty Emission Factor PM NOx(g/mi)	0.085	0.085
Light Duty Emission Factor PM (g/mi)	0.002	0.002
Light Duty Emission Factor NOx (g/mi)	0.084	0.084
Light Duty Emission Factor VOC (g/mi)	0.084	0.084
Light Duty Emission Factor SO2 (g/mi)	0.002	0.002
Light Duty Emission Factor CO (g/mi)	2.290	2.290
All Trucks Emission Factor GHG (gCO2eq/mi)	1,623.738	1,623.738

- Eliminates previous input requirements
- Directly uses **before & after travel times** as inputs
- Travel times obtained from traffic capacity software:
 - Synchro, SIDRA, etc.
- Provides more accurate travel time estimation
- Removes limitations and cumbersome steps of old tool

Intersection / Roundabout – Previous (2.3 a-d, 2.4)

4 Intersection Improvements

- Type A – New Signal
 - Unsignalized → signalized (reduce excessive delays)
- Type B – New Phase
 - Add new turn movement / change permissive → protected turn
- Type C – Capacity & Phase
 - Geometry redesign, capacity increase, or signal timing changes
- Type D – New Signal + Turn Lane
 - Unsignalized → signalized + additional turn lanes

1 Roundabout Improvement

- Construct roundabout at unsignalized or signalized intersections

Estimation Method

- Used **HCM-based delay reduction per vehicle**
- Aggregated delay reduction → calculate emission benefits

Intersection - New Signal and Turn Lanes				
CALCULATION INPUTS				
Data Type		User-Defined Values		
Scenario Year		2030		
Area Type		Residential		
New Signal Proposed Cycle Length (sec)		55		
Do you know the Effective Green to Cycle Length Ratios for Each Movement?		Y		
Peak Hour Intersection Delay before Improvement (s/veh)		20		
Peak Hour Intersection Delay after Improvement (s/veh)				
Street 1				
Facility Type		Two-Way Arterial (Parking)		
Percent Trucks		2%		
	Approach 1	Left	Through	Right
Number of Lanes After Improvement		1	2	No Turns
Peak Hour Volume		452	1,900	
	Approach 2	Left	Through	Right
Number of Lanes After Improvement		1	2	No Turns
Peak Hour Volume		563	864	
Street 2				
Facility Type		Collector		
Percent Trucks		5%		
	Approach 1	Left	Through	Right
Number of Lanes After Improvement		1	2	Shared Lane
Peak Hour Volume		653	1,080	100
	Approach 2	Left	Through	Right
Number of Lanes After Improvement		1	2	Shared Lane
Peak Hour Volume		897	600	268
Effective Green to Cycle Length Ratio (g/C)				
Effective Green to Cycle Length (g/C) - Street 1 Approach 1		0.67	0.67	0.67
Effective Green to Cycle Length (g/C) - Street 1 Approach 2		0.67	0.67	0.67
Effective Green to Cycle Length (g/C) - Street 2 Approach 1		0.14	0.14	0.14
Effective Green to Cycle Length (g/C) - Street 2 Approach 2		0.14	0.14	0.14

Intersection / Roundabout – Updated Single Tab (2.3)

•Simplified delay estimation

- Total delay reduction values entered directly as inputs
- Values taken from traffic capacity software (e.g., Synchro, SIDRA)
- Eliminates need for intermediate HCM calculations

•Consolidated improvements

- All intersection & roundabout improvements (prev. 2.3a–d, 2.4) now merged into a **single Section 2.3** in the updated tool

Intersection/Roundabout Improvement	
CALCULATION INPUTS	
	User-Defined Values
Scenario Year	2030
Percentage of Trucks (Volume-Weighted Average Across All Directions)	5%
Vehicle Hour Delay (Veh-hr) in Peak Hour - before Improvements	8.9
Vehicle Hour Delay (Veh-hr) in Peak Hour - after Improvements	3.9
EMISSION FACTORS AND CONSTANTS	
	Constants
Peak Hour to Daily Conversion	10
Number of weekdays per year	250
	Emission Factor
	2030
Light Duty Emission Factor GHG (g CO2eq/hour)	2226.99
Light Duty Emission Factor PM NOx(g/hour)	0.21
Light Duty Emission Factor PM (g/hour)	0.02
Light Duty Emission Factor NOx(g/hour)	0.34
Light Duty Emission Factor VOC(g/hour)	0.17
Light Duty Emission Factor SO2 (g/hour)	0.02
Light Duty Emission Factor CO (g/hour)	2.02
Truck Emission Factor for GHG (g CO2eq/hour)	6353.40
Truck Emission Factor for PM Nox (g/hour)	27.85
Truck Emission Factor for PM (g/hour)	0.35
Truck Emission Factor for NOx (g/hour)	26.36
Truck Emission Factor for VOC (g/hour)	1.49
Truck Emission Factor SO2 (g/hour)	0.02
Truck Emission Factor CO (g/hour)	15.48

Emission Rates Update

Model Setup

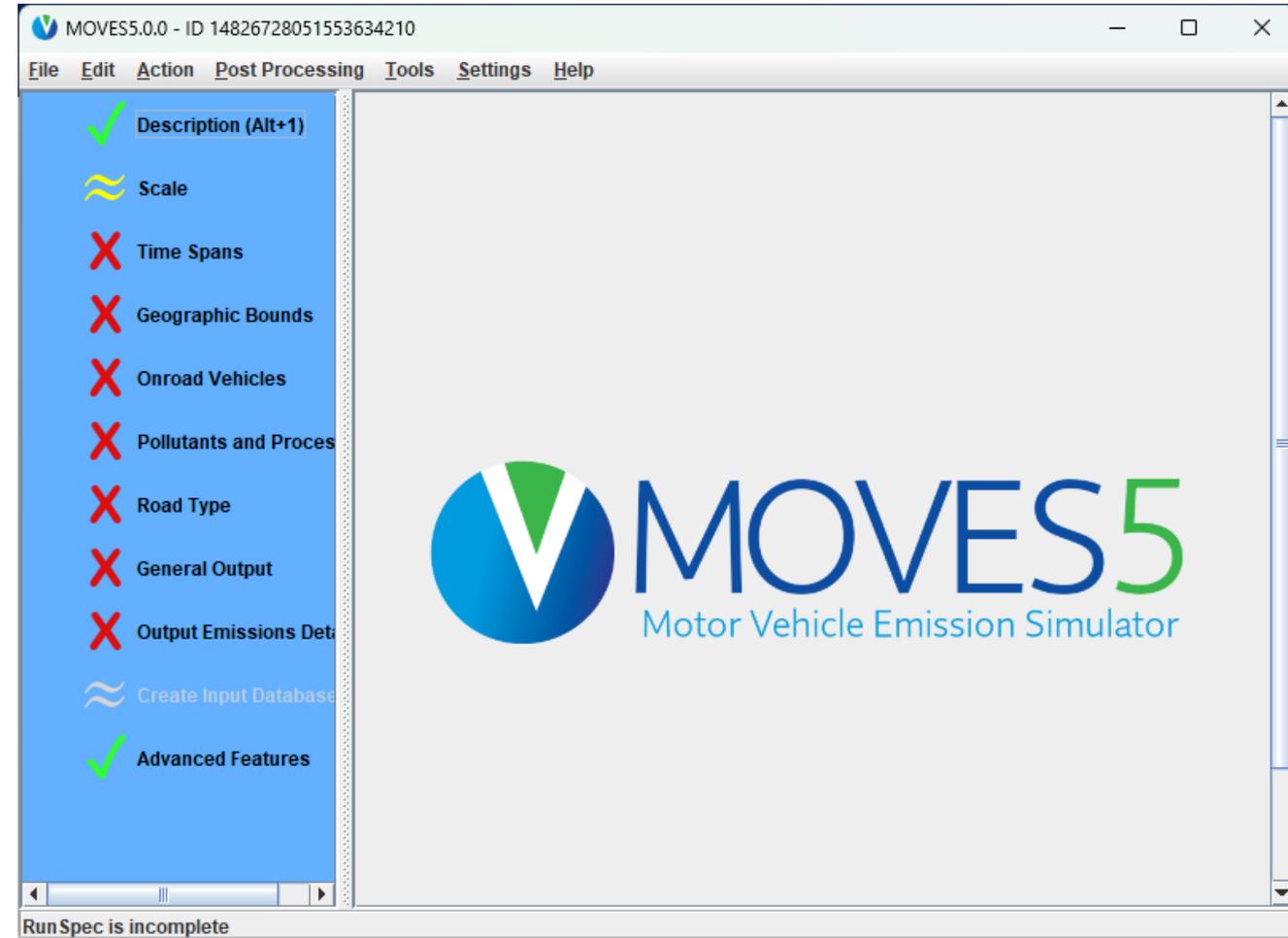
- Developed with EPA's most recent **MOVES5**
- Marion County, IN
- Analysis years updated: 2015 & 2025 → **2025 & 2035**
- Inputs aligned with IMPO datasets

Scenarios

- Annual: CO₂e, PM_{2.5}, NO_x, SO₂
- Summer: NO_x, VOC
- Winter: CO

Emission Rates

- **Running emission rates** (used in Tab 2.2)
- **Idle emission rates** (used in Tab 2.3)



Questions?

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