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MEMORANDUM: TAC WORK SESSION

To: NFRMPO Technical Advisory Committee

From: Medora Kealy

Date: October 11, 2018

Re: 2018 Call for Projects CMAQ Emissions Formulas

Background

The Colorado Department of Transportation (CDOT) convened a workshop on October 9, 2018 to develop recommended CMAQ emissions formulas to promote consistency across the state. The workshop attendees included staff from CDOT, the Denver Regional Council of Governments (DRCOG), the Federal Highway Administration (FHWA), the NFRMPO, the Regional Air Quality Council (RAQC), and the Upper Front Range (UFR).

The attachment describes and identifies the tools recommended at the CDOT workshop. **Table 1** lists the tool recommendations by project type. Also included are the tool recommendations from the Michigan Department of Transportation (MDOT). Finally, the attachment includes example emissions benefits calculations using the CDOT workshop tool recommendations for the most common project types.

Action

In preparation for the Action item on October 17, 2018, staff requests TAC discuss which CMAQ emissions tools to use in the 2018 Call for Projects.

CMAQ Emissions Calculator Toolkit – FHWA
- Developed by FHWA as an optional resource for DOTs, MPOs, and CMAQ project sponsors
- Currently provides six modules covering a variety of project types
- Since TAC last discussed emissions formulas in July, a new module has been added to the toolkit for Transit Bus and Fleet Expansion
- Additional modules are under development for Bicycle/Pedestrian Improvements and Diesel Idle Reduction Technologies for release in late 2018
- Emission rates are primarily based on a national-level run of the EPA MOVES2014a model
- https://www.fhwa.dot.gov/environment/air_quality/cmaq/toolkit/

GREET/AFLEET – Argonne National Laboratory
- Developed by Argonne Labs through funding from the Department of Energy
- County-specific for fuel profiles and upstream emissions
- Emissions factors are based on a combination of state-level EPA MOVES2014a data and operational analysis
- Updated annually with the most recent available data and studies
- AFLEET is a built tool that requires inputs and provides outputs
- GREET is the life-cycle assessment (LCA) model that allows for in-depth simulation parameter changes and provides operational and well-to-wheels (WTW) emission factors for vehicles
- https://greet.es.anl.gov/

TDM ROI Calculator – Mobility Lab
- Developed by Arlington County, VA, LDA consulting, and the University of South Florida with funding from USDOT
- Area-specific for traffic and density (choose from 103 metro areas)
- Users enter basic information about the TDM services they offer and the participation level of those services
- Loaded with data from more than 30 surveys from across the nation that users do not need to enter because it is embedded in the background of the tool
- Provides VMT reductions as well as return on investment for TDM and TCM projects
- Has some built-in calculations for emissions, but they are not area specific, offer few options and are not frequently updated
- https://mobilitylab.org/the-tdm-roi-calculator-and-manual/

Diesel Emissions Quantifier - EPA
- Developed by EPA
- Evaluates clean diesel projects and upgrade options for medium-heavy and heavy-heavy duty diesel engines
- Has some default values for fuel use and annual vehicle mileage
- https://cfpub.epa.gov/quantifier/index.cfm?action=main.home

CDOT Workshop - Not Recommended Tools

Michigan Department of Transportation (MDOT) Emissions Forms
- Developed by MDOT
- Currently provides seven forms covering a variety of project types
- As of August 2018, MDOT issued guidance[1] stating to use the FHWA Emission Calculator Toolkit whenever possible and only use MDOT Forms when an FHWA tool is not available
- https://www.michigan.gov/mdot/0,4616,7-151-9621_11041_60661---,00.html

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[1] MDOT, Congestion Mitigation and Air Quality (CMAQ) FHWA Toolkit and Emissions Form Guidance, https://www.michigan.gov/documents/mdot/MDOT_CMAQEmissionFormsInstr_437269_7.pdf.

Table 1. Recommended Tools by Project Type

Project Type	MDOT Recommendation	CDOT Workshop Recommendation	TAC Recommendation
Dedicated turn lanes, signal interconnects, signal optimization or actuation, and roundabouts	FHWA Traffic Flow Improvements Tool	FHWA Traffic Flow Improvements Tool	
Non-Motorized Pathway	*MDOT Form 2621*	FHWA Bicycle/Pedestrian Improvements Tool (to be released in late 2018)	
Intelligent Transportation System (ITS)	*MDOT Form 2612*	GREET/AFLEET	
Traffic Operations Centers Operations	*MDOT Form 2616*	-	
Travel Demand Management (TDM)	*MDOT Form 2619*	TDM ROI Calculator and GREET/AFLEET	
Park and Ride Lots	*MDOT Form 2613*	TDM ROI Calculator and GREET/AFLEET	
Carpooling, Vanpooling, and Rideshare	FHWA Carpooling and Vanpooling Tool	TDM ROI Calculator and GREET/AFLEET	
Operation of New Public Transit Services	*MDOT form 2620* (for more than one route, use *form 2620* for each route and sum the emission benefits in *form 2608*)	FHWA Transit Bus and Fleet Expansion	
Bus Purchase or Replacements	FHWA Transit Bus Retrofits and Replacement Tool	GREET/AFLEET	
Diesel Retrofits	FHWA Transit Bus Retrofits and Replacement Tool	EPA Diesel Emissions Quantifier	
Alternative Fuels and Vehicles	FHWA Alternative Fuels and Vehicles Tool	GREET/AFLEET	
Idle Reduction	-	GREET/AFLEET	
Alt Fuel Infrastructure	-	-	

Example Calculations

Auxiliary Lane – FHWA Traffic Flow Improvements Tool

Inputs	Road 1	Road 2
AADT (both directions)	55,000	6,400
Peak Hour Volume (both directions)	4,500	600
Number of Lanes (one direction)	3	1
Truck Percentage	4%	1%
Existing Delay per Vehicle (sec/vehicle)	8	60
Existing Left-turn Phase	Yes	Yes
Existing Right-turn Phase	No	No
Number of Left-Turn Lanes to Add	1	1
Planned Left-turn Phase	Yes	Yes
Planned Right-turn Phase	No	No
Ratio of Green Time per Cycle Time	.7	.3

Cost: $1,025,000

Emission	Total Emissions Reduced (KG)	Cost Effectiveness (Cost per KG)
NOx	75	$13,697
VOC	31	$32,578

Signal Synchronization - FHWA Traffic Flow Improvements Tool

Inputs

- Area Type – Urban
- Corridor Length – 4 miles
- Number of signalized intersections – 12
- Number of Lanes – 3
- Speed Limit – 50 mph
- Average Speed – 31 mph
- Expected Increase in Speed – 5 mph
- Average Cycle Length – 110 seconds
- Truck Percentage – 6%
- AADT – 55,000
- Peak-Hour Volume – 6,000
- Existing Corridor Travel Time – 10 minutes
- Cost – $800,000

Emission	Total Emissions Reduced (KG)	Cost Effectiveness (Cost per KG)
NOx	1,801	$444
VOC	1,069	$748

Non-Motorized Pathway – MDOT *Form 2621* (shown in place of the FHWA module, which is not yet available)

Inputs

- Length – 0.75 miles
- ADT – 58,000
- Percentage of bike/ped – 3%
- Average speed on road – 43 mph
- Cost – $1,000,000

Emission	Total Emissions Reduced (KG)	Cost Effectiveness (Cost per KG)
NOx	317	$3,148
VOC	113	$8,818

Alternative Fuel Bus Replacement – GREET/AFLEET

Inputs
- Old Fuel Type – Diesel
- New Fuel Type – CNG
- Old Model Year – 2010
- New Model Year – 2020
- VMT – 26,250
- Cost – $600,000
- Annual Fuel Gallons – 3,269
- Annual Idling Hours – 600
- Cost - $600,000

Emission	Total Emissions Reduced (KG)	Cost Effectiveness (Cost per KG)
NOx	170	$3,510
VOC	1	$433,448

Diesel Engine Repower – EPA DEQ

Inputs
- Vehicle Type – Short Haul Single Unit Class 6-7
- Old Engine Year – 2010
- New Engine Year – 2020
- VMT – 14,962
- Annual Fuel Gallons –14,962
- Annual Idling Hours – 30
- Cost - $10,000

Emission	Total Emissions Reduced (KG)	Cost Effectiveness (Cost per KG)
NOx	36	$275
VOC	N/A	N/A