



# MOVES2014

Briefing for NACAA

August 5, 2014

# What is MOVES2014?

- Motor Vehicle Emissions Simulator
- Released July 31, 2014
- A new model that replaces the MOVES2010 series (MOVES2010, MOVES2010a, MOVES2010b)
- Estimates emissions and energy use from all on-road sources at the national, county, and project scales
- Includes new emissions standards and new data for on-road vehicles
- Adds nonroad emission capabilities through the incorporation of NONROAD2008

# A Brief History of Model Releases

- The most recent official EPA on-road emission models for SIP and conformity analyses
  - 2004 – MOBILE6.2 (Included Tier 2 and PM emissions)
  - 2009 – MOVES2010 (First Release of MOVES, a major new approach)
  - 2014 – MOVES2014 (Includes Tier 3, and much more)
- We have also made minor/interim model updates to the official public versions
  - MOVES2010a, MOVES2010b

# MOVES2014 Changes Based on User Feedback and Peer Review

- Direct feedback on plans for MOVES2014
  - FACA workgroup
    - EPA presented details of technical updates on six, ½ day meetings
    - Reviewers included: Industry Trade Groups, Environmental Groups, Federal/State/Local Government, Research Consortiums, Academia
    - Presented several times to MSTRS
  - Peer review of eight MOVES2014 technical documents
  - Publication in peer reviewed scientific journals
- Feedback on MOVES2010 has informed improvements in MOVES2014
  - User feedback during training courses
  - MOVES workshop in 2011, attended by over 230 stakeholders
  - Support to air quality and transportation agencies
  - Feedback received at research conferences

# What's New in MOVES2014

- New OTAQ rules
  - Tier 3
  - HD GHG phase 1
  - LD GHG
- New science
  - Relied on dozens of new test programs and scientific studies
  - Future forecasts (VMT, population, sales)
- Improved functionality

# New Rules in MOVES2014

- Heavy-Duty Greenhouse Gas (HD GHG) MY 2014-2018
  - Decrease in heavy-duty energy consumption rates
  - Decrease in criteria pollutant emissions as a result of improved aerodynamics and rolling resistance.
  - Increase in criteria emissions from auxiliary power units
- Light-Duty Greenhouse Gas (LD GHG) MY 2017-2025
  - Decrease in light-duty energy consumption rates
- Tier 3
  - Decrease in light-duty and medium-duty emission rates
  - Reduction in gasoline sulfur level
  - Significant changes in vapor venting, permeation and evaporative leakage

# New Research Test Programs & Data used in MOVES2014

- Fuel Effects
  - EPAAct study on Gasoline fuel effects
  - Effects of E85 on emissions
  - EPA In-Use Sulfur Test Program
  - RFS2 renewable usage and future fuel supply
- Evaporative Emissions
  - CRC E-77 – Ethanol, RVP, leak magnitude study
  - High Evap Field Study – leak frequency
  - Running loss vapor leak study
  - Multiday Diurnal Testing
- PM Emissions
  - Speciation of Kansas City light-duty gasoline study
- Temperature Effects
  - EPA Cold Temperature Study
- Heavy Duty
  - In-Use Compliance Program PEMS data
  - Literature review of CNG Transit bus emissions
- Population and Activity
  - R.L. Polk Vehicle Population
  - AEO Vehicle Sales Projections
  - Updated FHWA VMT estimates
  - Flex-fuel vehicle penetrations
  - National average speed distribution using GPS data
  - Updated truck weights based on Weight-in-Motion data

# Other Updates to MOVES Data

- Emission Rates

- Updated toxic emission rates (metals, PAHs, dioxins)
- Updated refueling emissions algorithm
- Updated diesel start emissions
- Updated crankcase emission factors based on the ACES Heavy-duty engine test program
- Updated sulfate emission rates for diesel and gasoline
- Updated impact of 2007 Heavy-Duty Rule on HD gasoline emissions
- Updated light-duty diesel, E85 emission rates
- Updated biodiesel emission effects
- Updated CO2 equivalent factors
- Updated heavy-duty gasoline PM emission rates
- Included motorcycle fuel leaks
- Updated PM10 emission rate for brake and tire wear

- Population and Activity

- Incorporated state supplied data from the 2011 National Emission Inventory
  - Geographical Allocation
  - I/M Coverage
  - VMT
- Updates sales data for historic years (pre-2011)
- New heavy-duty drive cycles
- Updated ambient temperatures and relative humidities by county
- Added seasonal VMT motorcycle usage
- Updated extended idle calculations
- Improved operating mode assignment for project level analyses



# Functional Improvements in MOVES2014

- Improved integration of MOVES with air quality models
- Fuel Wizard
  - Automatically adjust fuel property changes based on user-made fuel property changes (e.g. ethanol)
- Added features for local inputs
  - Hoteling importer for local users to use own hoteling activity
  - Starts importer for local users to import own start activity data
  - Upgraded tool to estimate fleet-wide impacts of retrofit strategies
  - Additional road types to separately account for ramp activity
- GUI improvements
  - Better error checking, regulatory class output option, removal of leap years
- Added existing NONROAD model into MOVES

# Other Changes in MOVES2014

- Updated FHWA HPMS (Highway Performance Monitoring System) VMT
  - Past versions of MOVES have relied on this data (best available for the purpose)
  - FHWA updated its methodology since MOVES2010b
  - Has resulted in significant increase in heavy-duty VMT nationally
    - But local trend may be different
- Improved heavy-duty truck extended idle allocations
  - In MOVES2010b, extended idle was based on vehicle population
  - In MOVES2014, extended idle is based on rural highway VMT
    - In response to input from MARAMA
  - As a result, MOVES2014 now predicts no extended idle in urban counties with no rural highway VMT
    - Primarily affects PM and NOx emissions
  - MOVES2014 will offer an option to provide local extended idle activity, if available

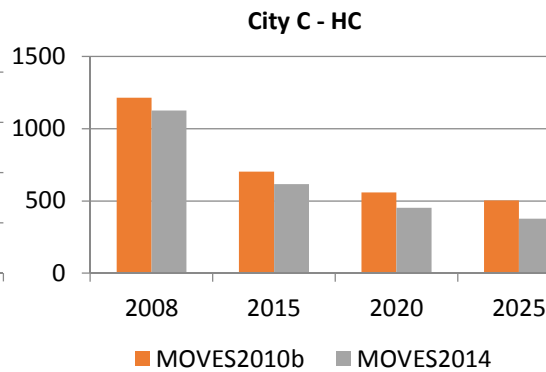
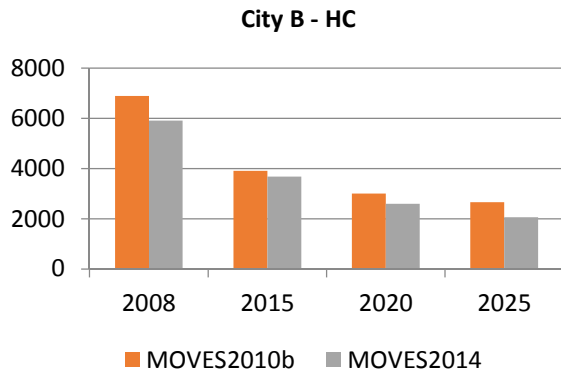
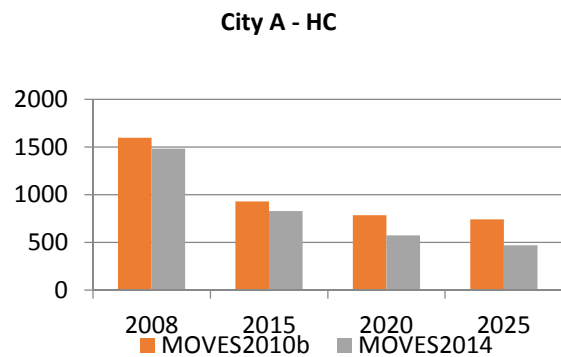
# How Do These Changes Affect MOVES2014 Users?

- Structure of MOVES2014 is essentially the same as MOVES2010
  - If you are already familiar with MOVES2010, the learning curve for MOVES2014 will be very short
- There are some changes in input table formats
  - We have provided a tool to convert MOVES2010b input files to MOVES2014 format, in the Tools menu of MOVES2014
  - Some additional modifications of certain tables may still be needed
- Output tables have additional columns to handle fields needed for nonroad output
- MOVES2014 Overview for Experienced Users on MOVES web page

# Example Inventory Impacts

- We have used local data provided by state agencies for 3 urban areas to show differences between model versions
  - Unique fleet mix, I/M program, fuels, temperatures, age distributions
  - Based on a single, core, urban county in each city, which may not completely reflect nonattainment area impacts
  - Includes national HPMS change
- Represents what a typical might see for their own MOVES2014 modeling, but actual differences between MOVES2010b and MOVES2014 may vary based on other local model inputs
  - We can't reflect the full range of possible outcomes in these examples
- MOVES2010b vs. MOVES2014 trends are consistent with our expectations
  - Tier 3, HD GHG phase 1, new data, new HPMS VMT

# Hydrocarbons

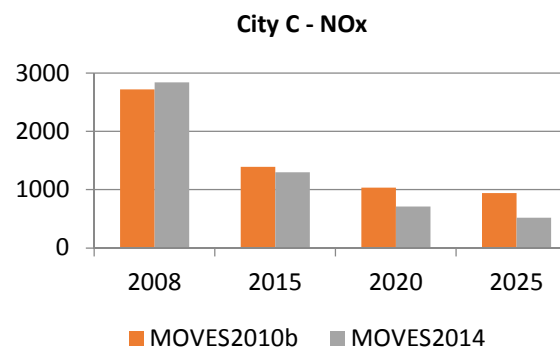
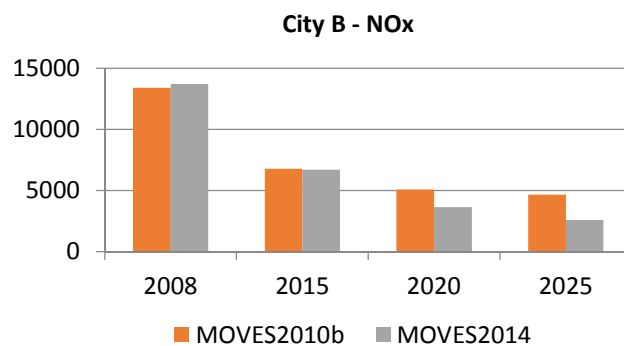
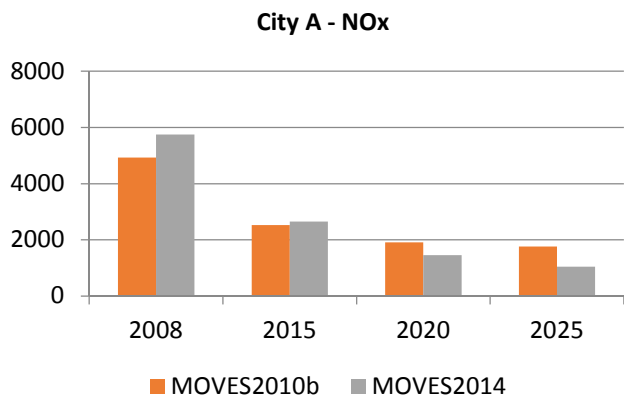


- Tier 3 reductions seen in 2020 and beyond
- Updates to evaporative and fuel effects

	Reduction from 2015 to 2025	
	MOVES2010b	MOVES2014
City A	-20%	-43%
City B	-32%	-44%
City C	-28%	-39%

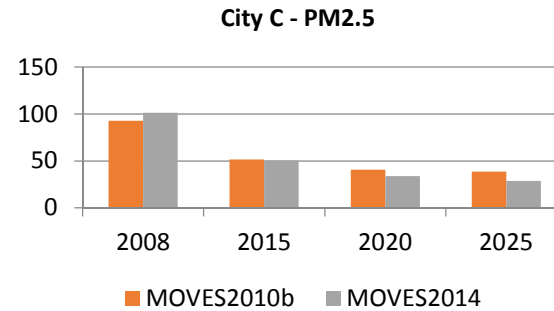
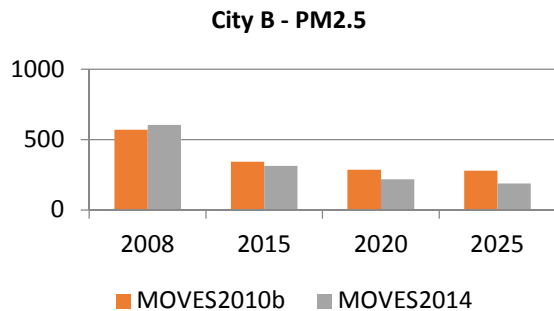
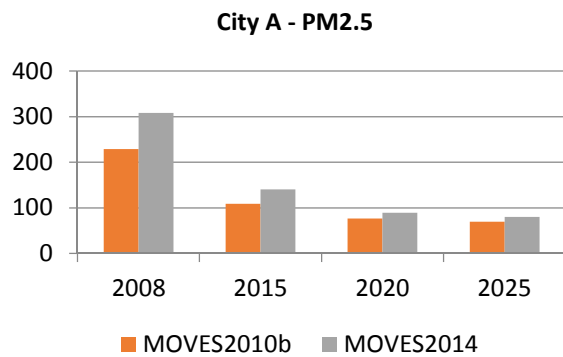
# Nitrogen Oxides

- Tier 3 and HD GHG reductions seen in 2020 and beyond
- Greater HD VMT increasing emissions



	Reduction from 2015 to 2025	
	MOVES2010b	MOVES2014
City A	-30%	-60%
City B	-31%	-61%
City C	-32%	-60%

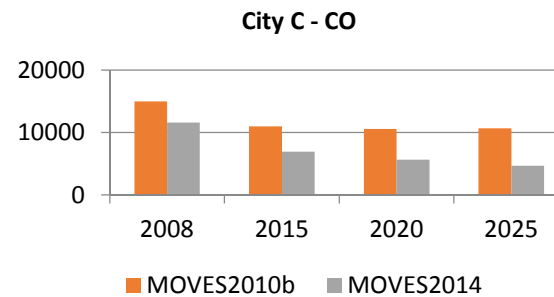
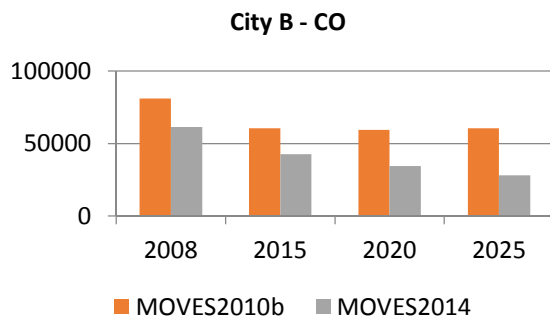
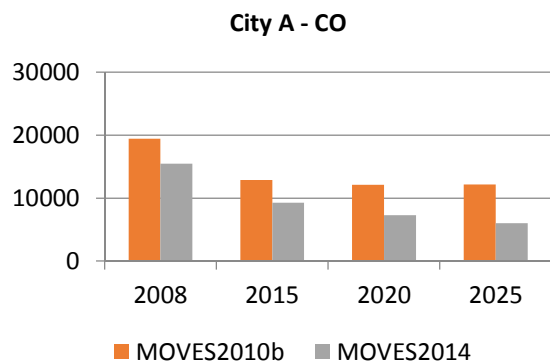
# PM<sub>2.5</sub>



- Tier 3 reductions seen in 2020 and beyond
- Greater HD VMT increasing emissions
- PM running emissions no longer sensitive to temperature (lowers emissions esp. in cold weather)

	Reduction from 2015 to 2025	
	MOVES2010b	MOVES2014
City A	-36%	-43%
City B	-18%	-40%
City C	-25%	-43%

# Carbon Monoxide



- Tier 3 reductions seen in 2020 and beyond
- Smaller cold start effect – emission reduction
- Less LD VMT reducing emissions

	Reduction from 2015 to 2025	
	MOVES2010b	MOVES2014
City A	-5%	-35%
City B	0%	-34%
City C	-3%	-33%



# Impact on SIPs and Conformity

- New control programs in MOVES2014 result in greater reductions in emissions over time, which should make it easier to demonstrate attainment
- Areas with SIP motor vehicle emission budgets based on MOVES2010b may have to redo those budgets to demonstrate conformity if MOVES2014 shows higher emissions
  - Example inventories indicate this may be necessary in some areas
- When a new model is released, our regulations provide a conformity grace period between 3-24 months
  - Grace period defines the period before MOVES2014 must be used for conformity
  - Grace period starts on publication date of FR notice of availability
- We are establishing a 2-year conformity grace period

# Nonroad in MOVES2014

- MOVES2014 incorporates existing NONROAD2008 model
  - Produces same results, but has more limited output options
- For SIPs, states can use either:
  - NONROAD2008
  - NMIM2008, or
  - MOVES2014
- Technical documentation can be found at:
  - [www.epa.gov/otaq/nonrdmdl.htm](http://www.epa.gov/otaq/nonrdmdl.htm)

# What is available now?

- MOVES2014 Installer
  - MOVES2014 code, installer, user guide, user interface reference manual
- MOVES2014 SIP and Conformity Policy Guidance
- MOVES2014 Questions and Answers
- MOVES2014 Overview for Experienced Users

# SIP and Conformity Policy Guidance

- Posted July 31, 2014
- Use MOVES2014 for SIP development as soon as possible
  - But work already begun using MOVES2010b can be completed
  - Work with your Regional Office if you have questions
- Two-year grace period before MOVES2014 must be used for conformity
  - Grace period begins with publication of Federal Register Notice of Availability
  - FR Notice publication expected September

# Technical Guidance

- Expected early September
- Most guidance is unchanged – can continue to rely on MOVES2010 Technical Guidance until release
- New guidance will address:
  - Optional starts and extended idle inputs
  - Use of Fuel Wizard for developing local fuel inputs
  - Option for adjusting age distributions in the future to reflect changing impacts over time of recent recession
- We will work with you if you need immediate help with any of those issues
- PM and CO hot-spot guidance documents will be updated later this fall

# Training

- Webinar on new features for users already familiar with MOVES2010
  - We will offer repeat sessions of the new feature webinar
  - We hope to schedule the first one within the next 2 weeks
- Updated 2-day hands-on training for new users
  - We will offer this first in Ann Arbor and then in a small number of other locations
  - We want to limit this course to new users only
  - We will begin scheduling this course in September
- Updated 3-day hands-on training for PM hotspot analysis
- We will announce courses via e-mails to our MOVES listserve and on our MOVES training page:
  - [www.epa.gov/otaq/models/moves/training.htm](http://www.epa.gov/otaq/models/moves/training.htm)

# Policy and Technical Support

- Model, guidance, Q&A document, links to technical documentation, presentations, and training page are all at:
  - [www.epa.gov/otaq/models/moves/index.htm](http://www.epa.gov/otaq/models/moves/index.htm)
- For questions about using MOVES in a particular area, please start by contacting your EPA Regional Office
- For general technical questions, including installation issues, use [mobile@epa.gov](mailto:mobile@epa.gov)
- MOVES installation is complicated because it requires installation and/or updates of JAVA, MySQL, and the MOVES application
  - Please read and follow the instructions provided carefully
  - We can't test all possible configurations of software you may have – check the troubleshooting section of the instructions if you have problems

# MOVES2014 Summary

- Includes new data to ensure MOVES is a state-of-the science model to estimate motor vehicle emissions
- Added new control programs (Tier 3, HD GHG phase I, etc.)
  - Most users will see emission reductions in the future as a result
- Other improvements based on user feedback
- Even with changes, structure of the model is fundamentally the same – this should ease the transition
  - But we will continue to provide technical support and training
- Ongoing commitment to continue to collect and analyze data to ensure that the next version of MOVES after MOVES2014 is based on the best science