



MOVES

Motor Vehicle Emission Simulator

MOVES3 Introduction & Overview

Presentation for Transportation Research Board
Modeling and Measurement Subcommittee of
GHG and AQ Committee (AMS10)
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Overview

- Background on MOVES
- What's new in MOVES3
- Comparison of MOVES3 and MOVES2014b Results
- Resources



Background on MOVES

- EPA's MOtor Vehicle Emission Simulator
- Estimates emissions and energy use for
 - Onroad vehicles
 - Nonroad equipment (except airplanes, locomotives, and commercial marine vessels)
- Estimates different types of emissions:
 - Engine running, engine starting, hotelling (extended idle), evaporative, brake and tire wear
- Estimates emissions of criteria pollutants, greenhouse gases (GHGs), and air toxics, and estimates fuel consumption
- Accounts for national emission standards, vehicle populations and activity, state and local rules, fuels, temperatures & humidity
- Used by EPA, states, tribes, local transportation and air agencies and others
 - However, California has its own onroad emissions model, EMFAC





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What's new in MOVES3



MOVES3

- This is the 3rd major MOVES release
 - Follows MOVES2010 and MOVES2014
- Includes new light-duty and heavy-duty emission rates based on peer-reviewed analyses of millions of emission test results and considerable advances in EPA's understanding of vehicle emissions
- Incorporates rules not in prior MOVES versions



Highlights: Light-duty and Fuel Updates

- Updated light-duty (LD) vehicle emission rates for hydrocarbons (HC), carbon monoxide (CO), and oxides of nitrogen (NO_x) based on in-use testing data
- Updated LD particulate matter (PM) rates, incorporating data on gasoline direct injection engines
- Added new fuel characteristic data from EPA fuel compliance submissions
- Incorporated the effects of the Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule on light-duty fuel economy



Highlights: Heavy-duty Updates

- Improved heavy-duty (HD) diesel running emission rates based on manufacturer-run in-use testing program data from hundreds of HD trucks
- Updated HD diesel starts and extended idle emission rates
- Updated emission rates for HD gasoline and compressed natural gas (CNG) trucks
- Incorporated the effects of the HD GHG Phase 2 rule



Highlights: Activity Updates

- Includes vehicle start and idling activity patterns based on real-world instrumented vehicle data:
 - “Off-network idle” accounts for emissions beyond the idling that is already considered in the MOVES drive cycles;
 - Default hotelling activity substantially reduced from MOVES2014, based on instrumented truck data;
- Updated national vehicle miles travelled (VMT) and vehicle population defaults with newer historical data from Federal Highway Administration (FHWA) and more recent forecasts from Department of Energy; and
- Updated national onroad vehicle default fuel, regulatory class, and age distributions based on newer vehicle registration data.





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Comparison of MOVES3 and MOVES2014b



Changes in Emission Estimates

- In general, MOVES3 national emission estimates are:
 - lower for most criteria pollutants in future years compared to MOVES2014b
 - higher for greenhouse gases in near future years compared to MOVES2014b
- Results will vary based on local inputs in a given area
 - Urban areas may see NO_x increases



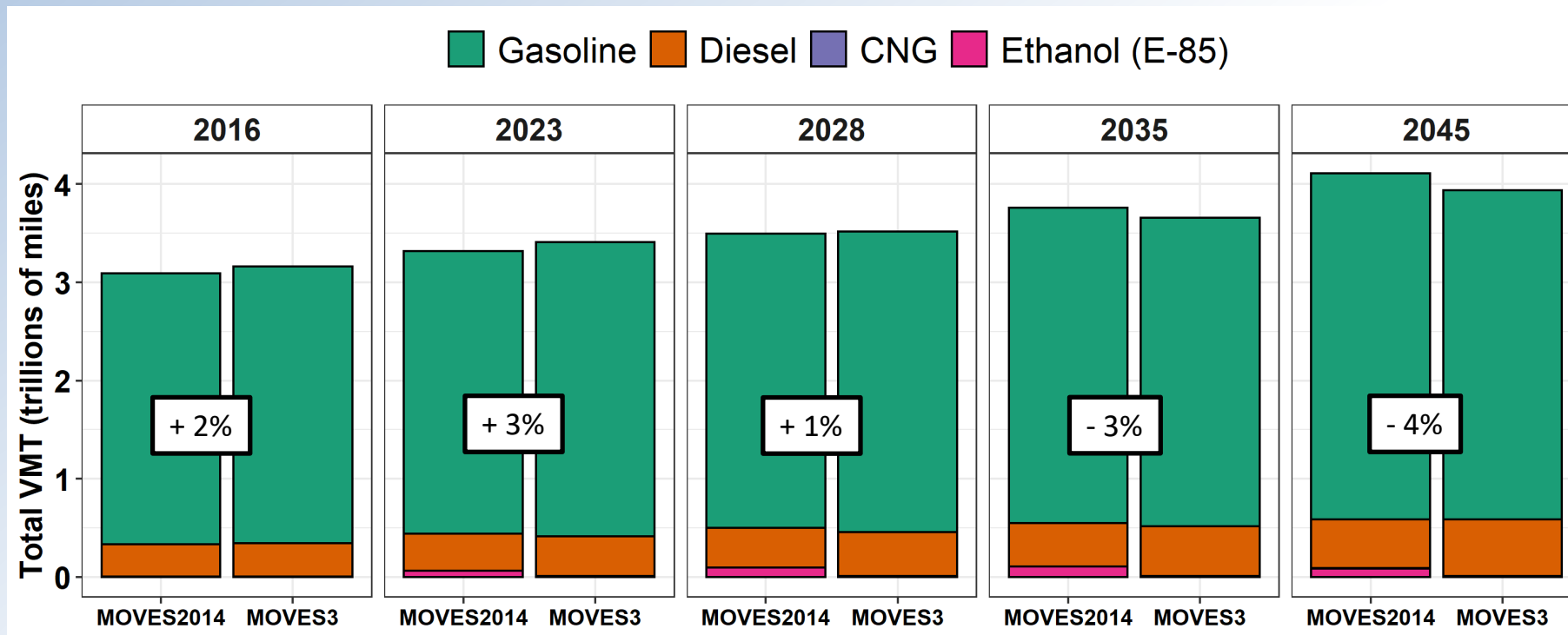
National Comparisons

- National annual results based on U.S. “average” activity, fuels, etc.
- Graphs compare MOVES2014b and MOVES3
- Nonroad changes (not shown) are limited to SO₂ and PM, which decrease with the decrease in diesel fuel sulfur levels.
 - Other nonroad results are virtually unchanged.



National: Onroad VMT

- Predicted VMT continues to increase across onroad sectors
- Small changes due to new historical data & new DOE Annual Energy Outlook (AEO) forecast

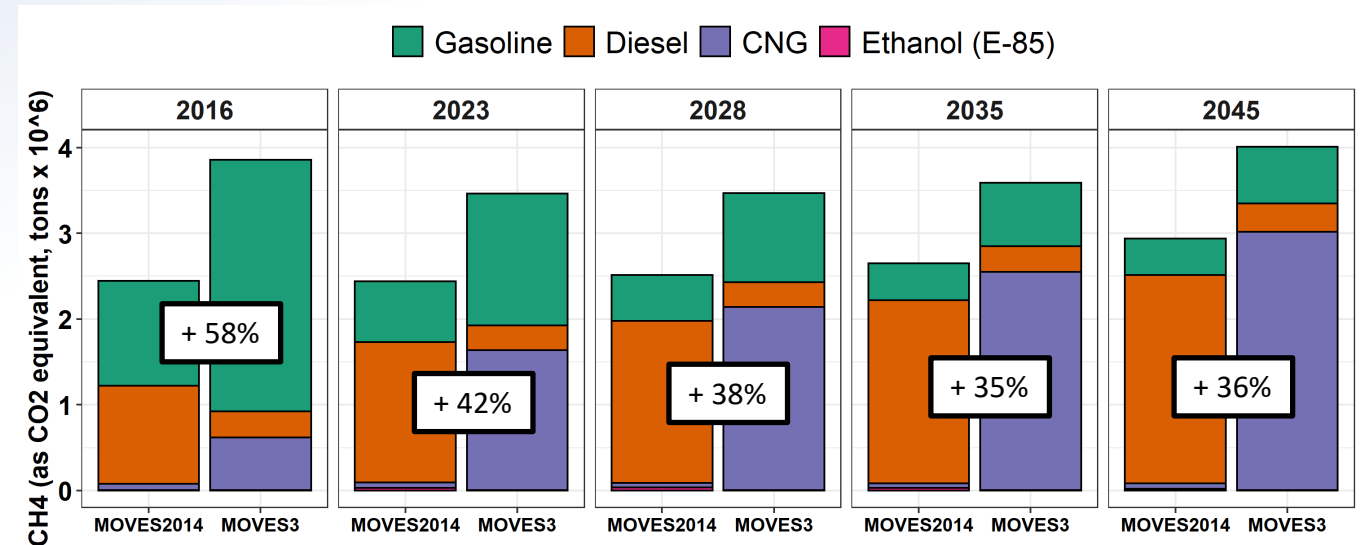
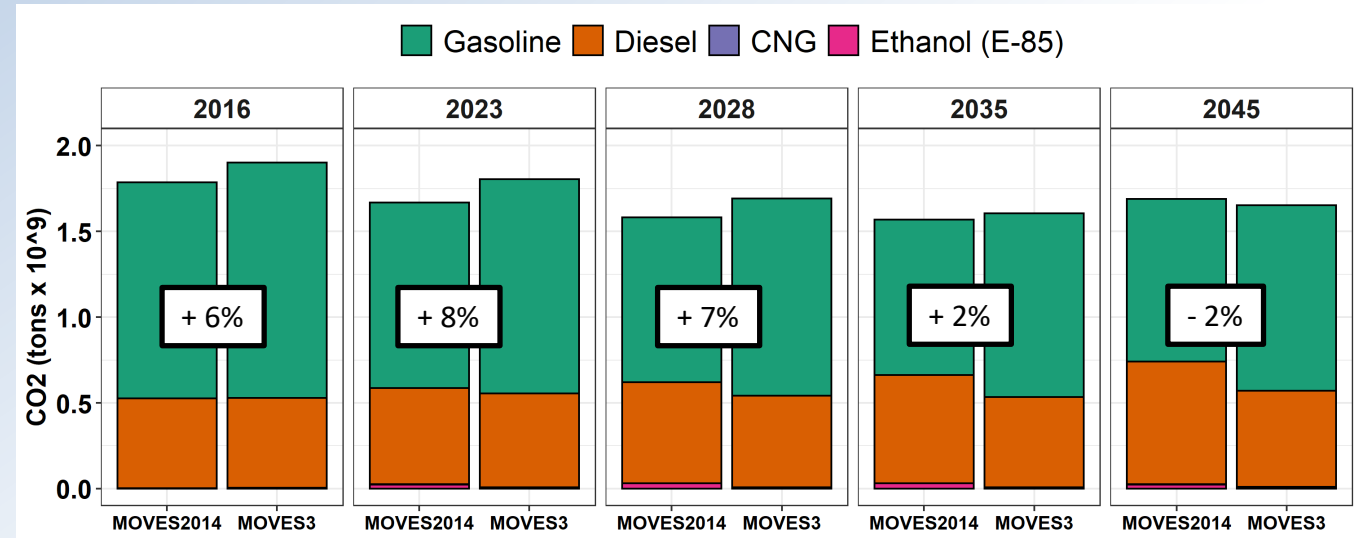


Percentage label indicates change from MOVES2014b to MOVES3.



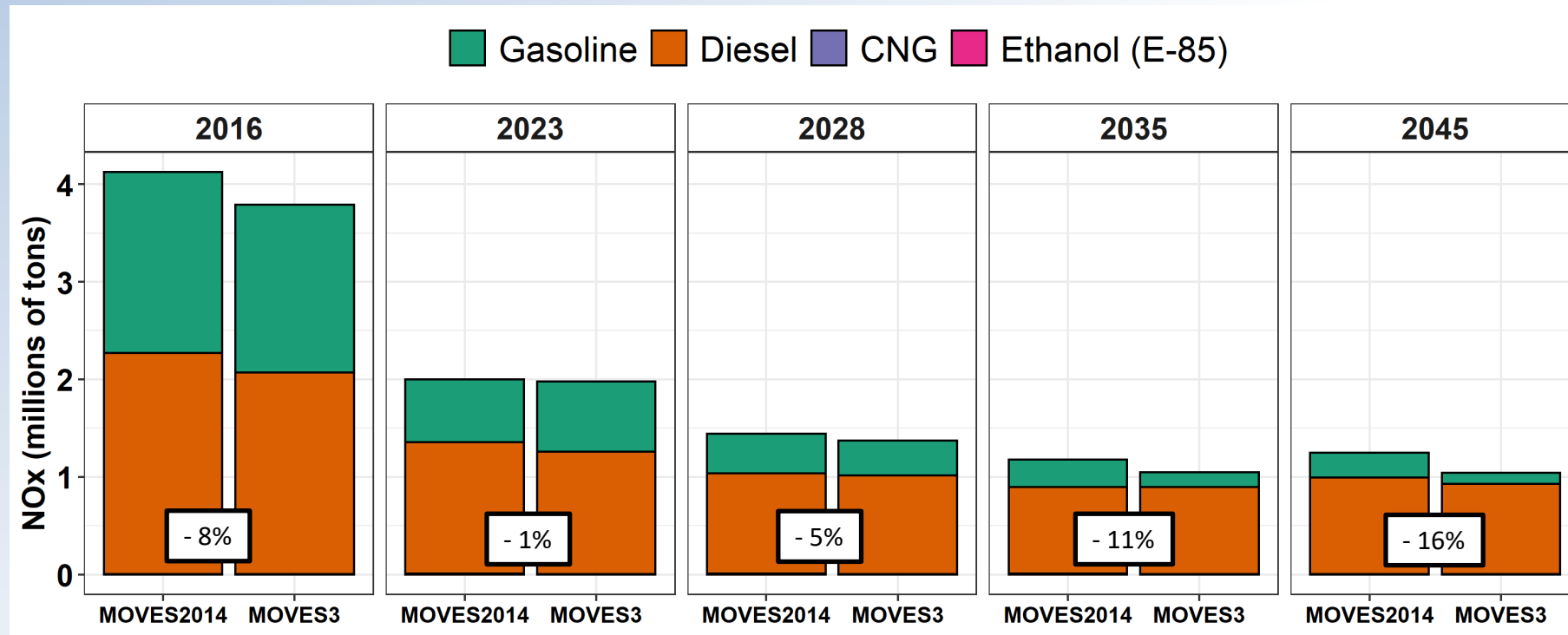
National: Onroad GHGs

- HD GHG Phase 2 rule reduces future diesel CO₂
- LD SAFE rule impacts seen in MOVES3 gasoline values
- Increase in CH₄
 - Updates to CNG population increase HD emissions
 - Updates to speciation (CH₄/THC ratios) change gasoline and diesel emissions
 - But still only a small fraction of GHG emissions.



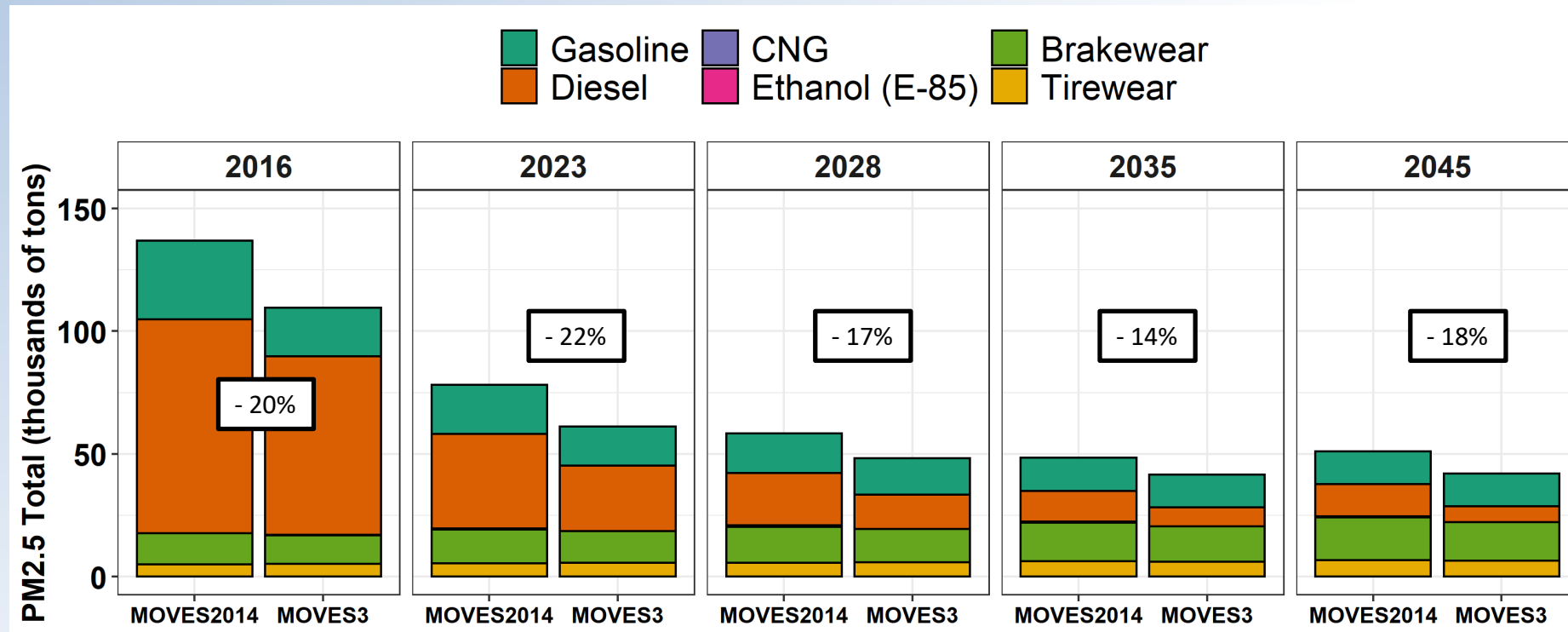
National: Onroad NOx

- Continue to see large drop in gasoline (LD) NOx with Tier 3
- At national scale, increase in diesel running NOx is outweighed by reduced extended idle from HD hotelling



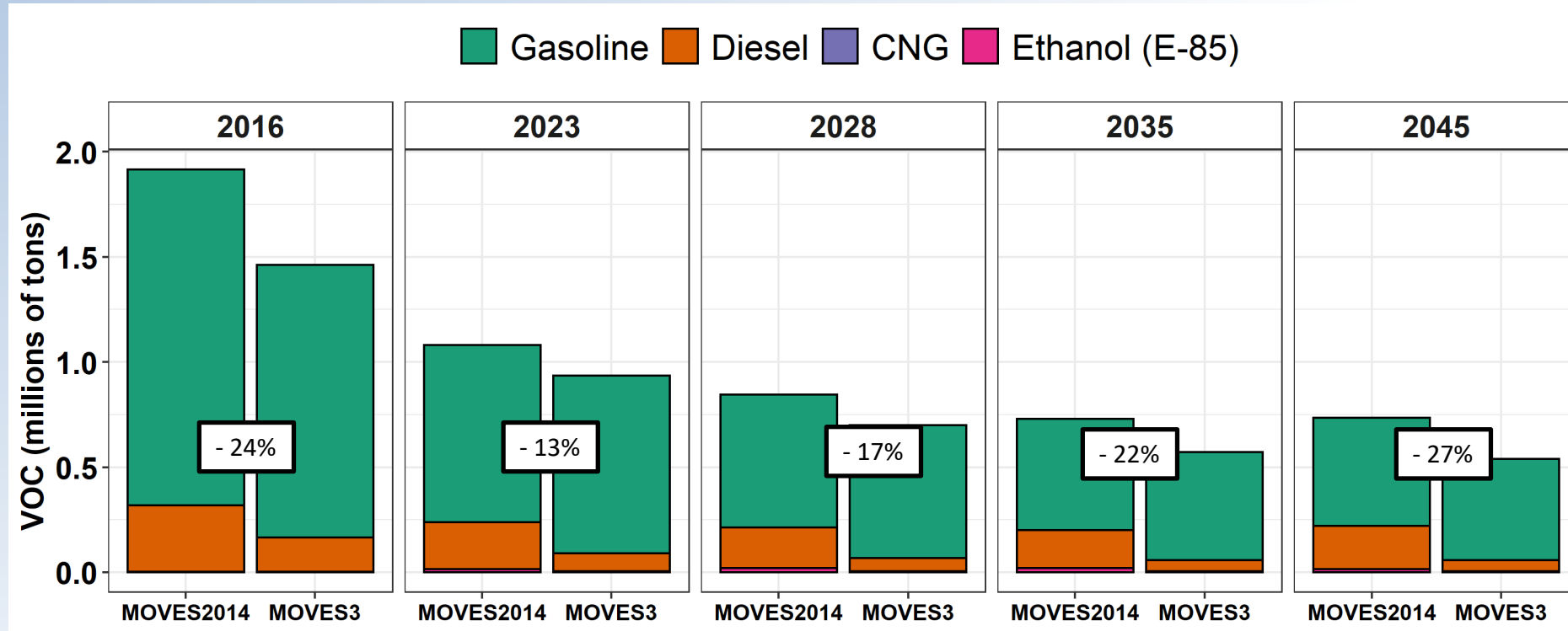
National: Onroad PM_{2.5}

- MOVES3 has less exhaust PM_{2.5} due to decreased extended idle activity and lower HD emission rates
- Brake and tire wear constitute a growing fraction of PM emissions



National: Onroad VOC

- Continue to see large drop in gasoline (LD) VOC with Tier 3
- Diesel declines in MOVES3 with extended idle
- Evaporative emissions are a growing fraction of future onroad VOC





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Resources



MOVES Webpage

<https://www.epa.gov/moves> with links to:

- Latest model (MOVES3)
 - EPA Releases MOVES3 Mobile Source Emissions Model: Questions and Answers
 - Policy and Technical Guidance
 - MOVES3 Installation File (Instructions and trouble shooting guide are included)
 - Links to training materials and additional user materials
- Limited use models (MOVES2014)
- Tools & Training
- Background Information
 - Technical Reports
 - MOVES Software Information on GitHub

The screenshot shows the EPA website's page for MOVES. The header includes the EPA logo and navigation links. The main heading is 'MOVES and Other Mobile Source Emissions Models'. A featured image shows a person at a computer with the text 'MOTOR Vehicle Emission Simulator (MOVES) Latest version of MOVES'. Below the image is a list of pollutants and emissions factors. To the right, a text box describes MOVES as a state-of-the-science modeling system. Below the featured content are three columns of links: 'MOVES and Other Mobile Source Emissions Models Using MOVES', 'Understanding Algorithms & Default Data', and 'Older Models'. A search bar is located on the right side of the page.



New location for MOVES source code and user support documents



Additional Resources

- MOVES3 Policy Guidance and Technical Guidance are also available at: www.epa.gov/state-and-local-transportation/policy-and-technical-guidance-state-and-local-transportation#emission
- Peer Review materials on EPA Science Inventory page: <https://cfpub.epa.gov/si/>
- Coming soon: *Federal Register* notice, other guidance updates, webinar for experienced users, and information about training
- Join EPA's MOVES listserv to receive MOVES announcements, including training: www.epa.gov/moves/forms/epa-mobilenews-listserv





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Thank you!

