



STEP UP
YOUR GAME



MOVES Modeling

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Overview

- What is MOVES?
- How we use MOVES?
- MOVES Applications

What is MOVES?

- From the US Environmental Protection Agency's (EPA) website, "EPA's MOtor Vehicle Emission Simulator (MOVES) is a state-of-the-science emission modeling system that estimates emissions for mobile sources at the national, county, and project level for criteria air pollutants, greenhouse gases, and air toxics."



Why do we use MOVES?

- Provide client deliverables
- State and local regulatory approved software
- Model emissions estimates for regulated pollutants
 - Criteria pollutants
 - Greenhouse gases
 - Air toxics
- Usually provide calculations for stationary sources

MOVES History

- EPA's Office of Transportation and Air Quality (OTAQ)
 - MOBILE & NONROAD
- Recommendations
 - Develop a modeling system more capable of supporting small-scale analysis
 - Improve characterization of emissions from high-emitting vehicles, heavy-duty vehicles, and off-road sources
 - Improve characterization of particulate matter (PM) and toxic emissions
 - Improve model evaluation
 - Long-term planning capabilities

MOVES History

- Initially published in 2003
 - Accommodate a large range of users
 - Satisfy recommendations and the CAA
 - Ease of customization
 - New characterization of emissions sources
- Latest version [MOVES5](#) (November 2024)
 - Includes emissions effects from EPA new rule
 - Updated estimates for electric vehicles
 - Updated fuel properties
 - Included new data
- EPA provides an [online download](#)



MOVES Overview

- *Source* – considers Onroad and Nonroad Engines
- *Source use type* – refines sources into specific classes based on activities
- *Source bins* – subset of source use types to differentiate emission levels
- Able to Forecast Estimated Emissions


Model

Onroad Estimate emissions from motorcycles, cars, buses, and trucks that operate on roads.

Nonroad Estimate emissions from nonroad equipment used in applications such as recreation, construction, lawn and garden, agriculture, mining, etc. Nonroad does not include aircraft, railroads, or commercial marine vessels.

Domain/Scale

Default Scale Use the default national database with default state and local allocation factors.

 **Caution:** Do not use this scale setting for SIP or conformity analyses. The allocation factors and other defaults applied at the state or county level have not been verified against specific state or county data and do not meet regulatory requirements for SIPs and conformity determinations.

County Scale Use this scale for SIP and regional conformity analysis. This scale requires user-supplied local data for most activity and fleet inputs.


Project Scale Use this scale for project-level analysis for conformity, NEPA, or other regulatory purposes where link-level analysis is needed. This scale requires user-supplied data at the link level for activity and fleet inputs that describe a particular transportation project.

Calculation Type

Inventory Mass and/or Energy within a region and time span.

Emission Rates Mass and/or Energy per unit of activity.

MOVES ScenarioID:

 **Caution:** Changing these selections changes the contents of other input panels. These changes may include losing previous data contents.

How Do We Use MOVES?

- Tool used to generate emission factors for onroad and nonroad engines
- Inputs from clients
- Techniques
 - Average monthly values from MOVES
 - Weekends vs Weekdays



MOVES Application – Carbon Footprint Reduction

- Natural Gas Client
- Explore reducing GHG emissions
- Client Ask: Will investing in water infrastructure to our sites reduce out GHG emissions?
- Deliverable Calculation Results – 687 tpy reduction of CO₂e

Inputs ¹		
Truckloads of water	15,000	
VMT/trip	50	
Pollutant ²	Emission Factor (g/VMT) ³	Annual Emission Rate (tpy)
Carbon Monoxide	0.83	0.6823
Carbon Dioxide	801.00	662.2164
Methane	0.01	0.0066
Oxides of Nitrogen	1.17	0.9694
Nitrous Oxide	0.10	0.0823
Sulfur Dioxide	0.003	0.0022
PM ₁₀	0.08	0.0700
PM _{2.5}	0.04	0.0328
CO ₂ e ⁴	--	686.9072

MOVES Applications – Resource Report 9

- Client Ask: Aid in building submission to FERC for their pipeline project.
- Submission to Federal Energy Regulatory Commission (FERC)
 - Deliverables:
 - 60-day Blanket Certificate Prior Notice (BPN)
 - RR9 Air and Noise Quality

Resource Report 9 Example Project

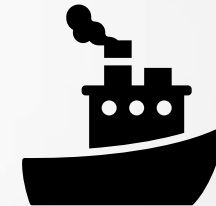
- Pipeline Replacement
- Timeframe – May – October 2025
- Results in Emissions Estimates

Equipment Type	SCC ¹	Fuel Type	Load Factor ¹	Engine Rating	Quantity	Total Days	Hours per Day	Total Project Hours	Brake-Specific Fuel Consumption ³
				(hp)					(g/hp-hr)
Air Compressors	2270006015	Diesel	0.43	275	2	6	8	48	166.47
Dozer	2270002063	Diesel	0.59	200	2	30	8	240	168.28
Excavators	2270002036	Diesel	0.59	200	6	180	8	1,440	168.28

MOVES Emission Factors ²									
NO _x	CO	VOC	PM ₁₀	PM _{2.5}	SO ₂	CO ₂	CH ₄	N ₂ O	Total HAPs
(g/hp-hr)	(g/hp-hr)	(g/hp-hr)	(g/hp-hr)	(g/hp-hr)	(g/hp-hr)	(g/hp-hr)	(g/hp-hr)	(g/hp-hr)	(g/hp-hr)
0.58	0.14	0.04	0.03	0.03	0.00	530.92	0.00	0.00	0.02
0.28	0.10	0.02	0.02	0.02	0.00	536.76	0.00	0.00	0.01
0.15	0.04	0.01	0.01	0.01	0.00	536.79	0.00	0.00	0.00

MOVES Application – Emissions Inventory

- Client Ask: Help develop an Emissions Inventory for their port operations.
- Deliverable: Emissions Inventory for a port
- Inventories help entities understand and manage environmental impacts
- Environmental Social Governance goal to reduce emissions at ports
- Determined - Ocean-going vessels contributed the most to overall emissions followed by heavy-duty vehicles
- Emissions reductions strategies determined
 - Increasing investment in shore power
 - Utilizing lower emitting fuels – hybrid/electric
 - Reducing energy consumption



Benefits to MOVES

- Saves time in calculating emissions
 - Run multiple sources and source modes at once
 - Run while completing other project work
 - Without MOVES calculating these emissions would almost be impossible

Selected	Pollutant	Running Exhaust	Crankcase Running Exhaust	Brakewear	Tirewear	Start Exhaust	Crankcase Start Exhaust	Extended Idle Exhaust	Crankcase Extended Idle Exhaust	Auxiliary Power Exhaust	Evap Permeation	Evap Fuel Vapor Venting	Evap Fuel Leaks
<input checked="" type="checkbox"/>	Total Gaseous Hydrocarbons	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	Non-Methane Hydrocarbons	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	Non-Methane Organic Gases	<input type="checkbox"/>	<input type="checkbox"/>			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/>	Total Organic Gases	<input type="checkbox"/>	<input type="checkbox"/>			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	Volatile Organic Compounds	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	Methane (CH4)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	Carbon Monoxide (CO)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			
<input checked="" type="checkbox"/>	Oxides of Nitrogen (NOx)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			
<input type="checkbox"/>	Nitrogen Oxide (NO)	<input type="checkbox"/>	<input type="checkbox"/>			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
<input type="checkbox"/>	Nitrogen Dioxide (NO2)	<input type="checkbox"/>	<input type="checkbox"/>			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
<input type="checkbox"/>	Nitrous Acid (HONO)	<input type="checkbox"/>	<input type="checkbox"/>			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
<input type="checkbox"/>	Ammonia (NH3)	<input type="checkbox"/>	<input type="checkbox"/>			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
<input checked="" type="checkbox"/>	Nitrous Oxide (N2O)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
<input checked="" type="checkbox"/>	Primary Exhaust PM2.5 - Total	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>			
<input checked="" type="checkbox"/>	[+] Primary Exhaust PM2.5 - Species	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>			
<input type="checkbox"/>	Primary PM2.5 - Brakewear Particulate			<input type="checkbox"/>									
<input type="checkbox"/>	Primary PM2.5 - Tirewear Particulate				<input type="checkbox"/>								
<input checked="" type="checkbox"/>	Primary Exhaust PM10 - Total	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>			
<input type="checkbox"/>	Primary PM10 - Brakewear Particulate			<input type="checkbox"/>									
<input type="checkbox"/>	Primary PM10 - Tirewear Particulate				<input type="checkbox"/>								
<input checked="" type="checkbox"/>	Sulfur Dioxide (SO2)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>			
<input checked="" type="checkbox"/>	Total Energy Consumption	<input checked="" type="checkbox"/>				<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>			
<input checked="" type="checkbox"/>	Atmospheric CO2	<input checked="" type="checkbox"/>				<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>			
<input checked="" type="checkbox"/>	CO2 Equivalent	<input checked="" type="checkbox"/>				<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>			
<input checked="" type="checkbox"/>	Benzene	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/>	Ethanol	<input type="checkbox"/>	<input type="checkbox"/>			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	1,3-Butadiene	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			
<input checked="" type="checkbox"/>	Formaldehyde	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			
<input checked="" type="checkbox"/>	Acetaldehyde	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			
<input checked="" type="checkbox"/>	Acrolein	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			
<input checked="" type="checkbox"/>	[+] Additional Air Toxics	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	[+] Polycyclic Aromatic Hydrocarbons (PAH)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	[+] Metals	<input checked="" type="checkbox"/>											
<input type="checkbox"/>	[+] Dioxins and Furans	<input type="checkbox"/>											
<input type="checkbox"/>	CB05 Mechanism	<input type="checkbox"/>	<input type="checkbox"/>			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	CB6CMAQ Mechanism	<input type="checkbox"/>	<input type="checkbox"/>			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	SAPRC07T Mechanism	<input type="checkbox"/>	<input type="checkbox"/>			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	CB6AE7 Mechanism	<input type="checkbox"/>	<input type="checkbox"/>			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

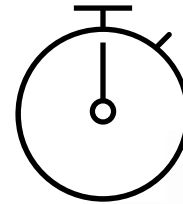
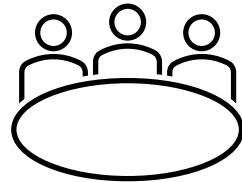
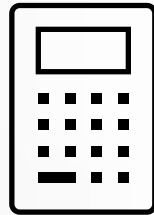
Challenges within MOVES

- Limitations/Challenges
 - Variable equipment types and capacities
 - Fuel type combinations
 - Geographic bounds

Fuels:	Source Use Types:	Selections:
Compressed Natural Gas (CNG) Diesel Fuel Electricity Ethanol (E-85) Gasoline	Combination Long-haul Truck Combination Short-haul Truck Light Commercial Truck Motor Home Motorcycle Other Buses Passenger Car Passenger Truck Refuse Truck School Bus Single Unit Long-haul Truck Single Unit Short-haul Truck Transit Bus	Passenger Car - Diesel Fuel Passenger Car - Electricity Passenger Car - Ethanol (E-85) Passenger Car - Gasoline Passenger Truck - Diesel Fuel Passenger Truck - Electricity Passenger Truck - Ethanol (E-85) Passenger Truck - Gasoline Single Unit Long-haul Truck - Compressed Natural Gas (CNG) Single Unit Long-haul Truck - Diesel Fuel Single Unit Long-haul Truck - Gasoline Single Unit Short-haul Truck - Compressed Natural Gas (CNG) Single Unit Short-haul Truck - Diesel Fuel Single Unit Short-haul Truck - Gasoline Transit Bus - Compressed Natural Gas (CNG) Transit Bus - Diesel Fuel Transit Bus - Gasoline

Conclusion

- MOVES aids in determining emissions from mobile sources
- Apply to a wide variety of projects
- Saves time in calculating emissions



Contact Information

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QUESTIONS?