A PRIMER ON EPA MOVES MODEL

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NATIONAL CAPITAL REGION
TRANSPORTATION PLANNING BOARD

MOVES: BASICS

- **Full Name**: MOtor Vehicle Emission Simulator

- **Purpose**:
  - An EPA-developed model to estimate emissions from mobile sources covering a broad range of pollutants
  - It allows analyses to be conducted at multiple dimensions (e.g., spatial, temporal, by vehicle type, by facility type etc.)
  - It is based on analysis of millions of emission test results (i.e., MOVES defaults) and considerable advances in EPA's understanding of vehicle emissions

MOVES: BASICS (continues)

- **Mobile emissions depend on a broad range of variables such as:**
  - *Travel variables* (e.g., VMT, VHT)
  - *Size and characteristics of existing and future year regional vehicle fleets* (e.g., vehicle type, age and population, etc.)
  - *Mode of operation* (e.g., speed distributions, operations on controlled/uncontrolled access facilities, ramps, idling etc.)
  - *Meteorological factors* (e.g., temperatures & humidity percentages)
  - *Existing and future technologies* (e.g., hybrid/electric vehicles, improved fuel efficiency vehicles, fuel formulation and supply, etc.)
  - *Regulatory Framework* (i.e., Tier 2 and 3 standards, Inspection & Maintenance Programs, other state programs, etc.)

THE EVOLUTION OF MOVES

Milestones	Dates	Significance
MOVES2010 Release	December 2009	Next generation emissions model from MOBILE6.2
Tier II	July 2010	New standards for light duty vehicles that will reduce GHG emissions and improve fuel economy (MY2012- 16)
MOVES2010a Release	August 2010	Incorporates new LDV and LDT GHG emissions standards (MY2012-16)
		Updates effects of corporate fleet average fuel economy in future years
		Incorporates small reductions in refueling and sulfur-related emissions due to reduced fuel consumption
MOVES2010b Release	June 2012	About 10% faster for runs at county level
		Added debugging features
		Improvements in error recovery, making network operations more efficient
		More detailed outputs
		Air toxics emissions calculations improved
		Newer versions of Java (v.1.7.0) and MySQL (v.5.5.12)
Tier III	April 2014	New emissions standards for light duty vehicles and some heavy-duty vehicles; lower sulfur content of gasoline beginning in 2017

KEY APPLICATIONS of MOVES at TPB

- **Air Quality Conformity**:
  - Ozone Pollutant (VOC and NO_X)
  - Fine Particles (Direct $PM_{2.5}$ and Precursor NO_X)
  - Carbon Monoxide (CO)

- **Greenhouse Gas (GHG) Emissions** (measured in tons/year)**:**
  - Atmospheric CO_2
  - Methane (CH_4)
  - Nitrous Oxide (N_2O)

- **State Implementation Plans (SIPs)**

- **Project Level Analysis (Hot Spot and NEPA) by Consultants**

STRATEGY TESTING USING MOVES

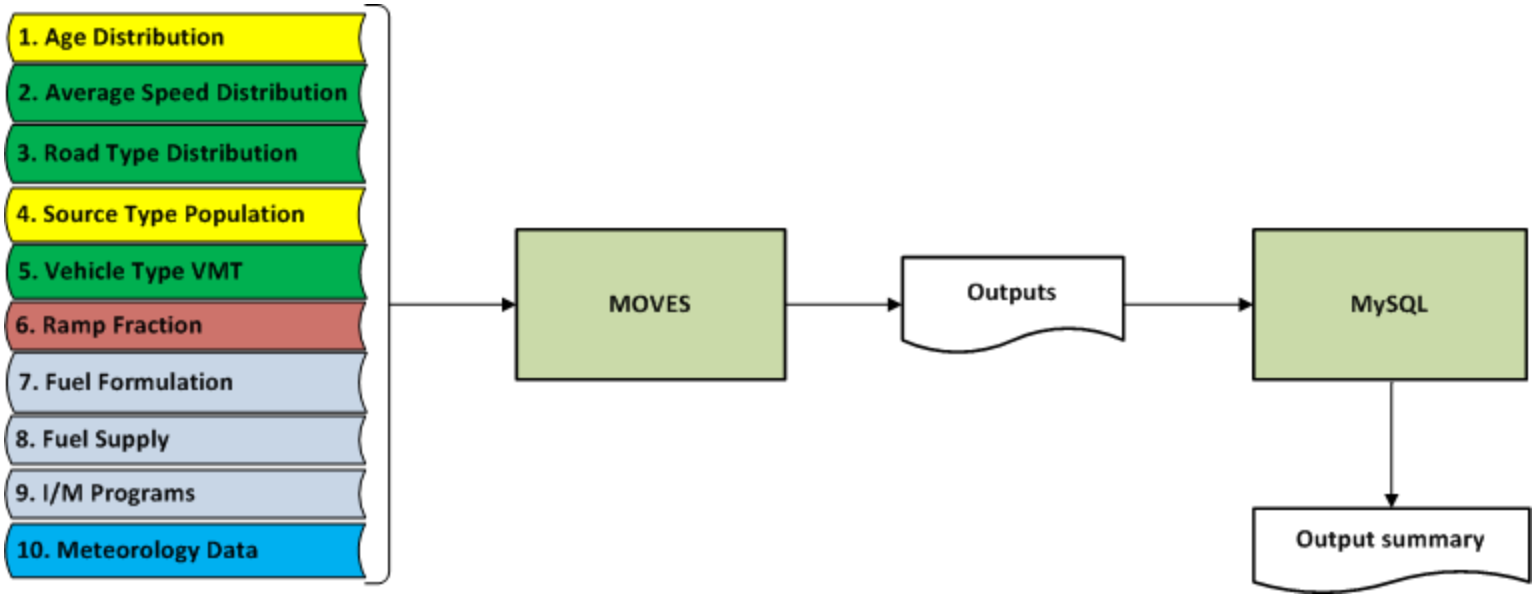
- Emissions reductions from the Telework TERM of the Commuter Connection Program
- Emissions reductions from Car Free Day
- Emission reductions from the Metropolitan Area Transportation Operations Coordination (MATOC) Program
- Emissions reductions from regional pedestrian facilities expansions and enhancements
- Scenario Testing (e.g., land use & smart growth, toll lanes, BRT networks, etc.)

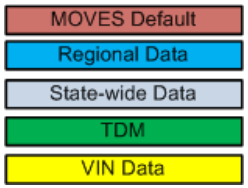
MOVES: MODELING OPTIONS

- **Execution**:
  - Inventory Mode (currently used for conformity and SIPs)
  - Emission Rate Mode
- **Analysis Areas:**
  - Geographic Boundaries: Nation, State, County or City
  - Custom Domain
- **Time Dimension:**
  - Year, Month, Week, Day of week or Hour of day
- **Output Summary:**
  - Spreadsheet-based
  - MySQL Script

MOVES: MODELING PROCESS

Input data categories



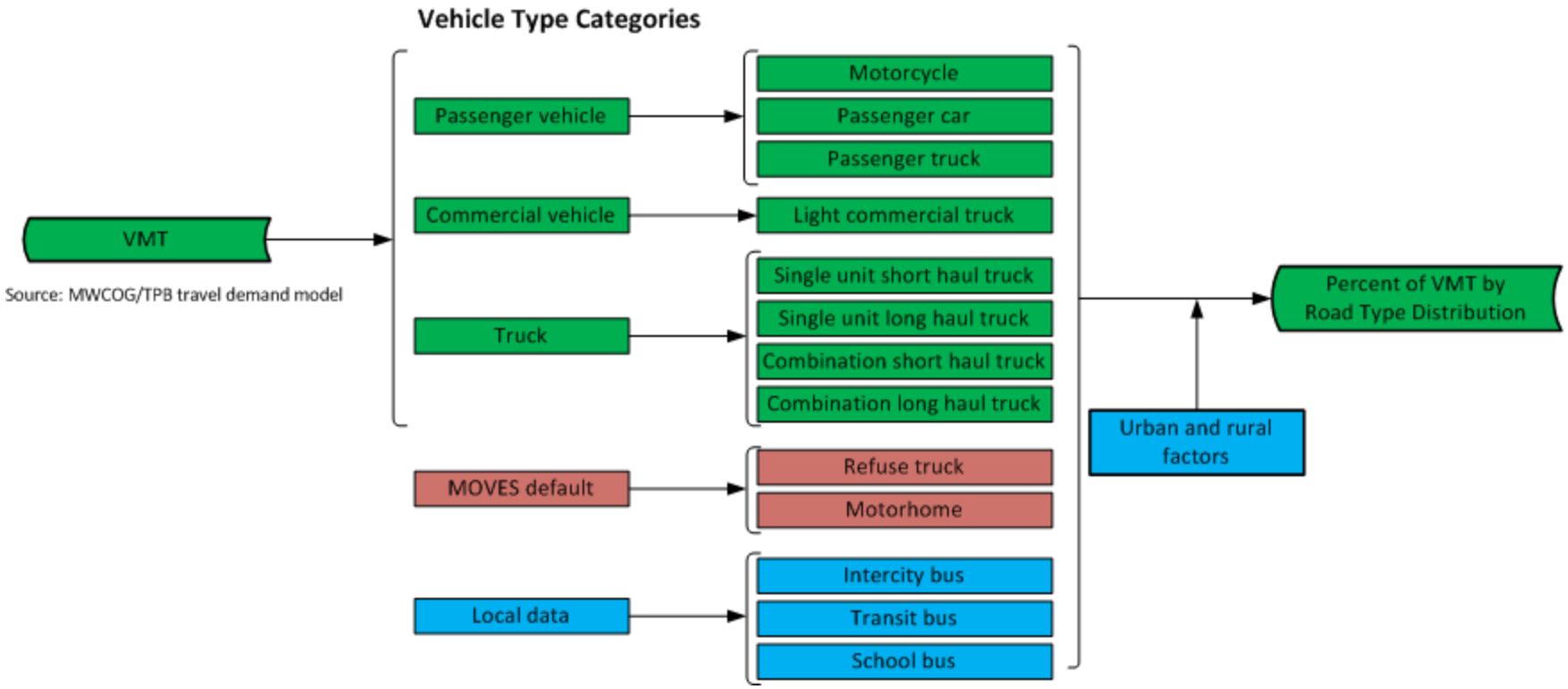


MOVES: SOURCES OF INPUTS

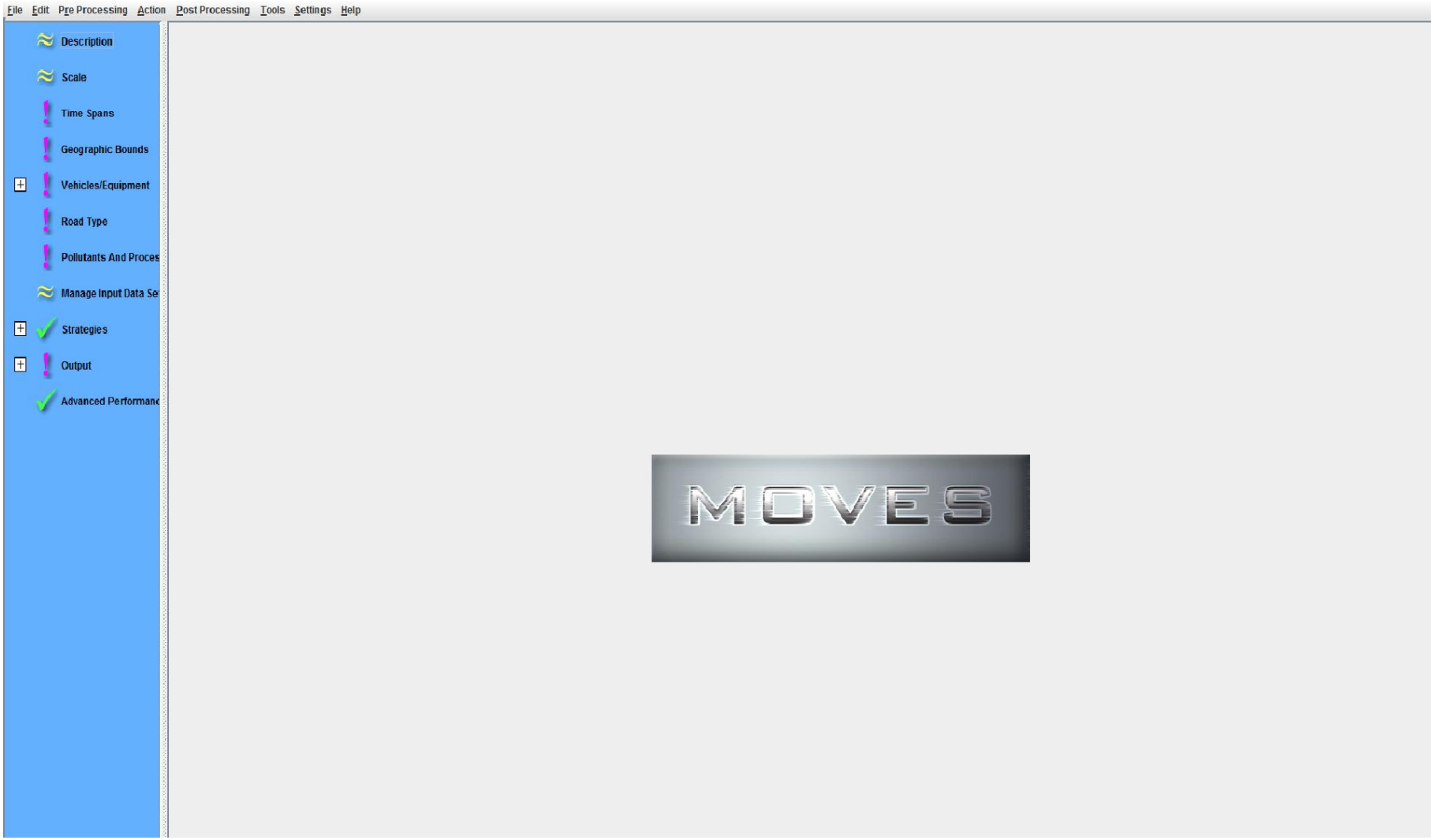
	Data Category	MOVES Name	Origin	Data Source
1	Age Distribution	sourceTypeAgeDistribution	County	VIN Databases
2	Average Speed Distribution	avgSpeedDistribution	County	TDM Post-Processor Fairfax Co. (school buses & refuse trucks) WMATA (transit buses)
3	Road Type Distribution	roadTypeDistribution	County	TDM post-processor
4	Source Type Population	sourceTypeYear	County	VIN Databases & jurisdictional growth rates
5	Vehicle Type VMT	HPMSVTypeYear	County	TDM Post-Processor
		monthVMTFraction	Region	Regional Data
		dayVMTFraction	Region	Regional Data
		hourVMTFraction	Region	Regional Data
6	Ramp Fraction	roadType	Region	MOVES Default
7	Fuel	FuelSupply	State	MD-DC-VA Air Agencies
8		FuelFormulation	State	MD-DC-VA Air Agencies
9	I/M Programs	IMCoverage	State	MD-DC-VA Air Agencies
10	Meteorology Data	zoneMonthHour	State	Local Airport Monitors

MOVES: MODELING PROCESS

VMT Allocations by Road Type



MOVES START UP SCREEN



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MOVES POLLUTANT MENU SCREEN

File Edit Pre Processing Action Post Processing Tools Settings Help

- Description
- Scale
- Time Spans
- Geographic Bounds
- Vehicles/Equipment
- Road Type
- Pollutants And Proces
- Manage Input Data Se
- Strategies
- Output
- Advanced Performanc

	Running Exhaust	Start Exhaust	Brakewear	Tirewear	Evap Permeation	Evap Fuel Vapor Venting	Evap Fuel Leaks	Crankcase Running Exhaust
Total Gaseous Hydrocarbons	✔	✔			✔	✔	✔	✔
Non-Methane Hydrocarbons	✔	✔			✔	✔	✔	✔
Non-Methane Organic Gases	✔	✔			✔	✔	✔	✔
Total Organic Gases	✔	✔			✔	✔	✔	✔
Volatile Organic Compounds	✔	✔			✔	✔	✔	✔
Carbon Monoxide (CO)	✔	✔						✔
Oxides of Nitrogen (NOx)	✔	✔						✔
Ammonia (NH3)	✔	✔						✔
Nitrogen Oxide (NO)	✔	✔						✔
Nitrogen Dioxide (NO2)	✔	✔						✔
Sulfur Dioxide (SO2)	✔	✔						✔
Primary Exhaust PM10 - Total	✔	✔						✔
Primary PM10 - Organic Carbon	✔	✔						✔
Primary PM10 - Elemental Carbon	✔	✔						✔
Primary PM10 - Sulfate Particulate	✔	✔						✔
Primary PM10 - Brakewear Particulate			✔					
Primary PM10 - Tirewear Particulate				✔				
Primary Exhaust PM2.5 - Total	✔	✔						✔
Primary PM2.5 - Organic Carbon	✔	✔						✔
Primary PM2.5 - Elemental Carbon	✔	✔						✔
Primary PM2.5 - Sulfate Particulate	✔	✔						✔
Primary PM2.5 - Brakewear Particulate			✔					
Primary PM2.5 - Tirewear Particulate				✔				
Total Energy Consumption	✔	✔						
Petroleum Energy Consumption	✔	✔						
Fossil Fuel Energy Consumption	✔	✔						
Brake Specific Fuel Consumption (BSFC)	✔							
Methane (CH4)	✔	✔						✔
Nitrous Oxide (N2O)	✔	✔						✔
Atmospheric CO2	✔	✔						
CO2 Equivalent	✔	✔						
Benzene	✔	✔			✔	✔	✔	✔
Ethanol	✔	✔			✔	✔	✔	✔
MTBE	✔	✔			✔	✔	✔	✔
Naphthalene	✔	✔			✔	✔	✔	✔
1,3-Butadiene	✔	✔						✔
Formaldehyde	✔	✔						✔
Acetaldehyde	✔	✔						✔
Acrolein	✔	✔						✔

Questions?