MOVES - NONROAD Model Development :

Overview

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FACA MOVES Review Workgroup November 27, 2012









Overview

- NONROAD Model Summary
- Model Outputs
- Software Update

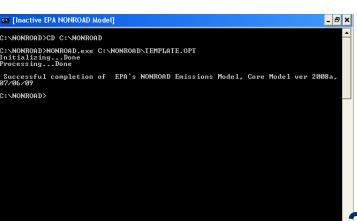




NONROAD2008a Model Summary

- Used to estimate NONROAD equipment emission inventories in the USA.
 - EPA Rulemaking Inventories
 - State and Local Usage
- Geographical scale from county to national
- Models major pollutants and processes (exh & evap)
- Calendar year coverage 1970 through 2050
- Models most equipment types except locomotive, commercial marine and aircraft









NONROAD Summary (cont'd 1)

• Equipment Categories / Sectors

- Recreational
- Construction
- Industrial
- Lawn/Garden
- Agriculture
- Commercial
- Logging
- Airport Service
- Underground Mining
- Oil Field
- Pleasure Craft
- Railroad Service

• Fuels

- Gasoline
- Diesel
- LPG
- CNG





NONROAD Summary (cont'd 2)

- Development began with the 1991 NEVES Study
- Core code and algorithm developed in 1995
 - Population and activity inputs based on PSR
- First public version released in 1998
- Updated incrementally in 2000, 2002, 2005 and 2008
- Coded in FORTRAN95 with a reporting utility coded in Visual Basic 2003
- Utilized in EPA National Mobile Inventory Model (NMIM) package
 - NMIM released in 2005
 - Runs MOBILE6 and NONROAD with a JAVA/MySQL GUI interface
 - Generates county, state and national emission inventories





NONROAD Model

- NONROAD Emission/Fuel Equation
- Emissions = Population * Activity * EmissionFactor * LoadFactor * RatedPower
 - Where
- Population
- Activity
- EmissionFactor
- LoadFactor
- RatedPower

- >>>> Engine population
- >>>> Annual activity (hrs/yr)
- >>>> Emission rate (g/hp-hr)
- >>>> Fraction of available power
- >>>> Average power (hp)





NONROAD Model (cont'd 1)

• Population

>>>> Derived from CY 2003 PSR sales/pop data

- >>>>>Base Year Population: 1996, 1998, 1999, or 2000>>>>>growth assumptions>>>>>scrappage assumptions>>>>>Snowmobile registration data, Motorcycle Industry Council
- Activity >>>> 1998 PSR database
 - >>>> Based on surveys of equipment owners>>>> Not a function of age

LoadFactor

>>>> Limited transient testing + PSR

- >>>> Combines ALL operating modes together
- >>>> Computed using actual vs maximum fuel consumption

Rated Power

>>>> PSR data

>>>> Categories separated by horsepower bin





NONROAD Model (cont'd 2)

Geographic Allocation	>>>> Variety of category specific surrogates
Emission Factors	>>>> 1991 NEVES study California ARB testing EPA Small Engine Model (1995, 96, 99, 02, 08) Steady-state testing Emission standards with compliance margin
Deterioration Factor	<pre>>>> EF * Ef_{new} * DF >>>> DF = 1 + k * (AgeFactor) b >>>> AgeFactor = (Activity*LF)/(medlife@full hours)</pre>
WEB SITE	>>>> http://www.epa.gov/oms/nonrdmdl.htm



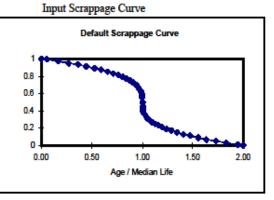


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NONROAD Model (cont'd 3)

• Growth / Scrappage

>>>> reverse cumulative normal distribution scrappage curve



• Median Lifetime (years) >>> Median Life (hrs) /(Activity * LF)

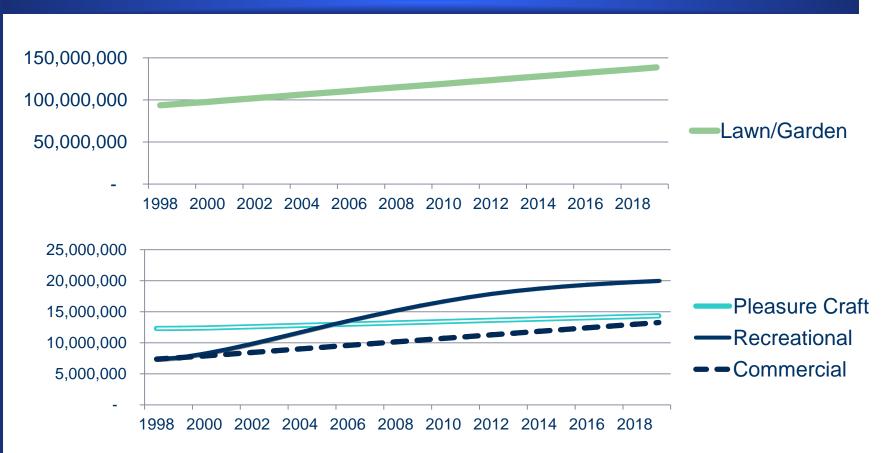
>>>>	200 hrs for small gas
>>>>	7000 hrs for large diesel

- Growth: SalesGrw = PopGrw / { [(-1.4306 x PopGrw) x MedLifeYrs] + (-0.24 x PopGrw) + 1.0 }
- Growth Factors Function of equipment type and calendar year not linear





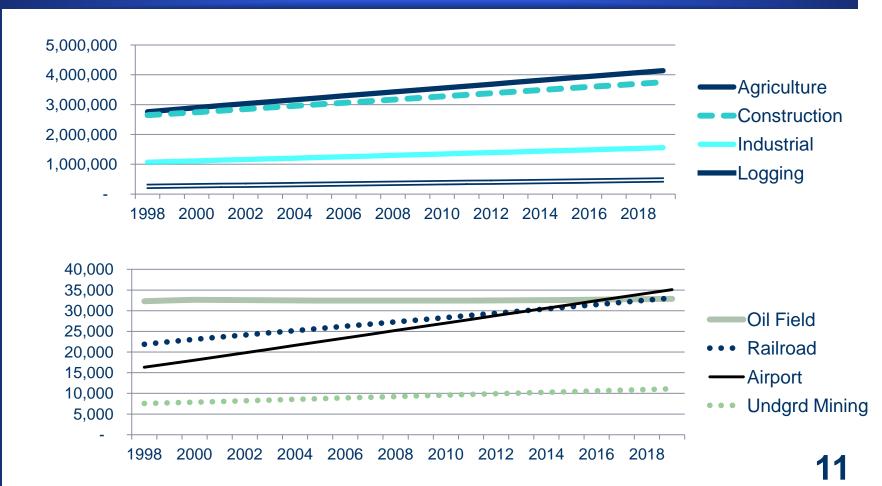
NONROAD Equipment Population by Sector





NONROAD Equipment Population by Sector (cont'd)

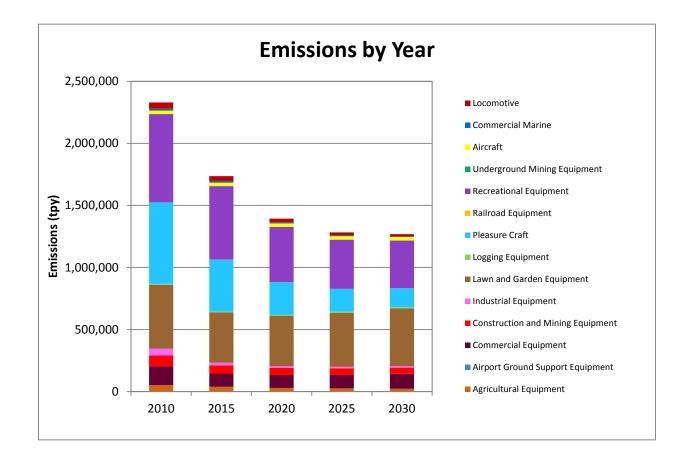
MOVES







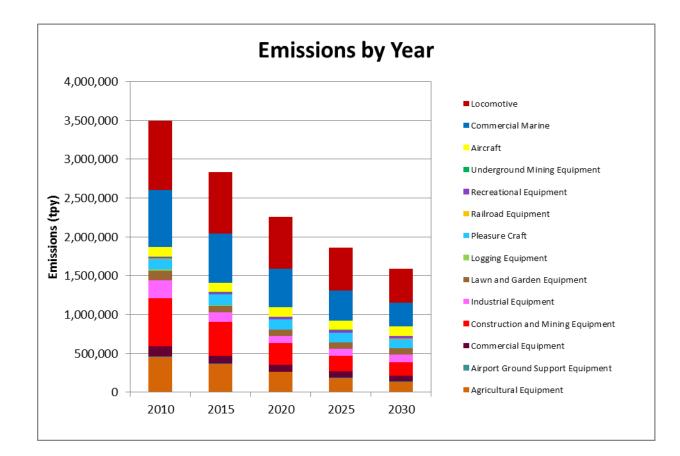
National NONROAD Sector VOC Emissions by Category







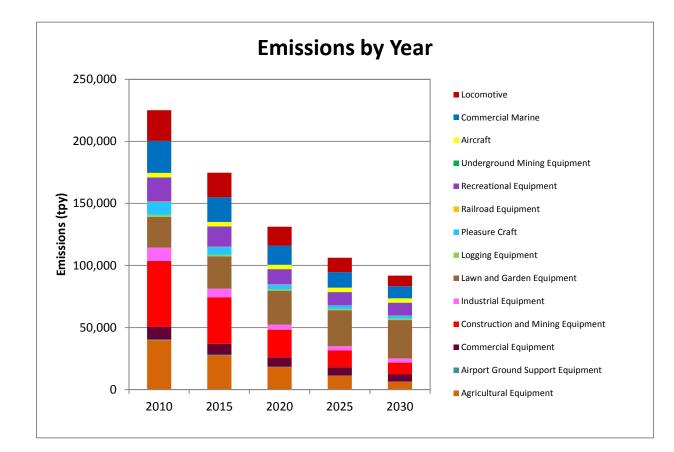
National NONROAD Sector NOx Emissions by Category







National NONROAD Sector PM2.5 Emissions by Category







Why Add NONROAD to MOVES?

• Ease of use

- Produce same user interface for on-road and non-road
- Allow easier input of user data
- Create consistent highway vehicle and non-road equipment inventories

• NONROAD software platform is outdated

- Doesn't work with current Windows/Linux platforms
- GUI Interface is limited and inflexible
- Block data is difficult to edit
- Programming is highly rigid and difficult to modify





MOVES – NONROAD Software

• Fully database driven

- Emission rates
- Population / Allocation data
- Activity

• User friendly data input

- Spreadsheet based
- Analogous to on-road MOVES input

• Convenient output of results

- Range of disaggregation / aggregation
- Customized scripts
- Performance
 - Similar to current NONROAD model
 - Interactive GUI or batch operation





MOVES – NONROAD Scale/Model Screen

ile <u>E</u> c	dit P <u>r</u> e Processing <u>A</u> ction	<u>P</u> ost Processing <u>T</u> ools <u>S</u> ettings <u>H</u> elp	
100	Description	Model	-
	Description	Onroad To run ONROAD model only.	
	Scale	○ Nonroad To run NONROAD model only.	
	Time Spans	Domain/Scale	
		$\textcircled{\sc 0}$ National $\sc 0$ Use the default national database with default state and local allocation factors.	
	Geographic Bounds	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	
+	Vehicles/Equipment	state or county data and do not meet regulatory requirements for	
	Road Type	SIPs and conformity determinations.	
		County Select or define a single county that is the entire domain.	
	Pollutants And Proces	Note: Use this scale setting for SIP and regional conformity analysis. Use of this scale setting requires user-supplied local data for most	
	😂 Manage Input Data Sei	activity and fleet inputs.	
1	wanaye niput Data Sei	O Project Use project domain inputs.	
+	Strategies	Note: Use this scale setting for project-level analysis for conformity, NEPA, or any other regulatory purpose. Use of this scale setting requires	
		user-supplied data at the link level for activity and fleet inputs that	
+	Output	describe a particular transportation project.	
	Advanced Performanc	Calculation Type Mass and/or Energy within a region and time span.	
		 Emission Rates Mass and/or Energy per unit of activity. MOVESScenarioID: 	
		MUVE35Cendriolo,	





MOVES – NONROAD Equipment Screen

Deparimtion	Fuels:	Sectors:	Selections:
 Description Scale Time Spans Geographic Bounds Vehicles/Equipment NonRoad Vehicle Road Type Pollutants And Proces Manage Input Data Set Strategies 	Compressed Natural Gas (CNG) Diesel Fuel Electricity Gasoline Liquefied Petroleum Gas (LPG) Placeholder Fuel Type	Agriculture Airport Support Commercial Construction Highway mobile Industrial Lawn/Garden Logging Oil Field Pleasure Craft Railroad Recreational Underground Mining	Diesel Fuel - Construction
+ Output			
Advanced Performanc	Select All	Select All	Delet





MOVES – NONROAD Output Screen

ile <u>E</u> dit	P <u>r</u> e Processing	<u>A</u> ction	Post Processing Tools Settings Help	
1	Time Spans			
1	Geographic Boun	ids—	Always On Road/Off Road	
Ξ 🧹	Vehicles/Equipm	em	COUNTY On Road Decision	
	📝 NonRoad V	ehi	Pollutant Road Type Source Use Type	
1	Road Type	00000000	for All Vehicle/Equipment Categories	
1	Pollutants And P	TOC DOT	Fuel Type Off Road	
~	🕻 Manage Input Dat	ta ' =	Emission Process	
± 🧹	Strategies	addadadada	Estimate Uncertainty	
Ξ [Output	dadadadada	Number of iterations: 2	
	General Ou	tpi	Keep pseudo-randomly sampled input	
	💞 Output Emi	ssi	Keep output from each iteration	
1	Advanced Perfor	ma		
-				

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MOVES 2013 Schedule (for NONROAD)

• Insertion of NONROAD Fortran code into the MOVES model

- Mostly complete
- Final debugging and testing
- Release of NONROAD2008a in MOVES2013 as "draft"
- Continue to develop MOVES NONROAD after release of MOVES2013