



Heavy-Duty CNG Vehicles in MOVES

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MOVES Review Work Group

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Background

- MOVES2014
 - Allows users to model Compressed Natural Gas (CNG) only for transit buses
 - Emission rates for CNG based on CNG transit bus data
 - Based on MY 1996-2004 model year CNG transit buses
 - Rates for 2007+ model years are based on scaling the base emission rates using engine certification data
 - Population of CNG transit buses provided in the default MOVES database
 - National average fraction of CNG vehicles for 2011+ model years in MOVES2014 is 15.8%



Interest in CNG

- MOVES users have expressed interest in modeling CNG in other vehicle types (e.g. refuse trucks)
- We recognize there is a significant use of CNG in other heavy-duty source types¹
- However, data are not as readily available on CNG vehicle populations for other source types
- For example, CNG in freight applications are mostly retrofitted after sale, making it difficult to track their market share

1. Boyce, B. 2014. Cummins Westport - Heavy Duty Natural Gas Engines for Trucks and Buses presented at the Southeast Alternative Fuels Conference & Expo, October 22, Raleigh, NC, USA. <http://www.altfuelsconference.org/>.



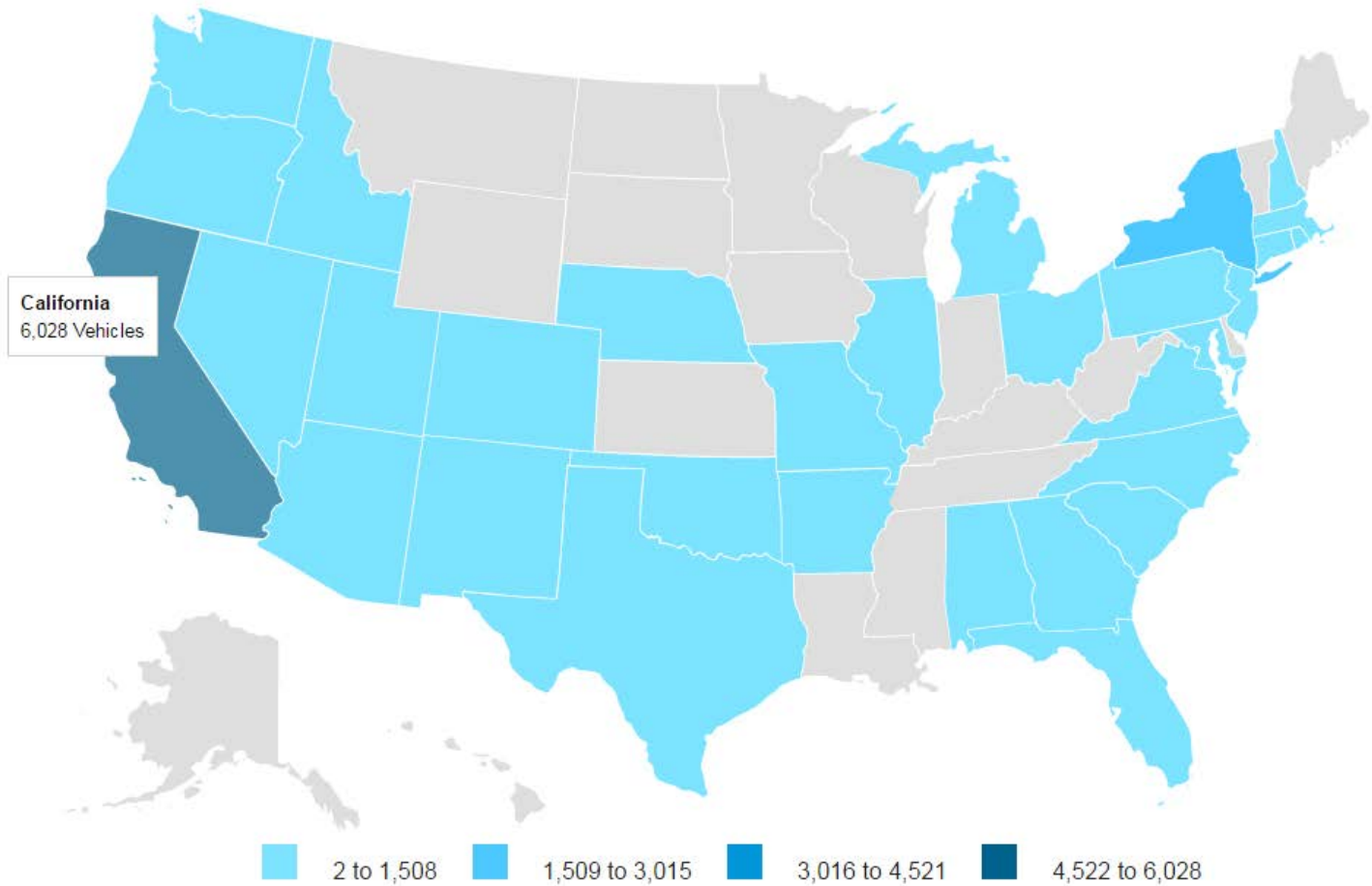
Proposal for Next Version

1. Remove CNG vehicles from default population in MOVES
 - The current national default CNG usage for transit buses does not reflect the actual CNG usage well in individual states, counties, and metropolitan areas
 - CNG usage varies significantly in different geographic regions across the US, due to:
 - Financial incentives to implement CNG usage vary by area
 - CNG is implemented by vehicle fleets (e.g. transit agencies, refuse haulers) which tend to either have a high % of CNG use or no CNG use



Dedicated CNG Medium- and Heavy-duty Vehicles by State

State fleet vehicles - CNG (2015)



Source: U.S. Energy Information Administration.
<https://www.eia.gov/renewable/afv/users.php?fs=a&ufueltype=CNG>



Proposal for Next Version (cont'd)

2. Allow users to supply CNG use for all heavy-duty source types in MOVES, including:

- Intercity Bus
- Transit Bus
- School Bus
- Refuse Truck
- Single Unit
- Motor Homes
- Combination Trucks
- MOVES users can enter fraction of CNG-fueled vehicles by source type through the AVFT importer (Alternative Vehicle Fuel Table)



Use of County Data Manager

The screenshot displays the MOVES County Data Manager application window. The title bar reads "MOVES County Data Manager". The interface features a series of tabs at the top, each with a green checkmark icon, indicating they are active or available. The tabs include: Vehicle Type VMT, Hotelling, I/M Programs, Retrofit Data, Generic, Tools, Ramp Fraction, Road Type Distribution, Source Type Population, Starts, RunSpec Summary, Database, Age Distribution, Average Speed Distribution, Fuel (highlighted in blue), and Meteorology Data. Below the tabs, there is a section titled "Description of Imported Data:" with a large empty text area. To the right of this area is a "Fuels Wizard" button. Below the description area, there are two rows of buttons: "Clear Imported Data" and "Create Template..." for both the description area and the "AVFT Data Source:" section. The "AVFT Data Source:" section includes a "File: (please select a file)" label with a red arrow pointing to it, and a "Browse..." button. Below these buttons is an "Import" button. At the bottom of the window, there are two buttons: "Export Default Data" and "Export Imported Data". A pink bar at the bottom right of the window contains the text "Fuel", and a "Done" button is located at the bottom right corner.

Users can create template and import CNG vehicles in the Fuel Tab of the County Data Manager (County-scale) and the Project Data Manager (Project-scale)

Use of AVFT

- Updates intercity bus (sourceTypeID 41) fuel fraction to 50% diesel (fuelTypeID 2) and 50% CNG (fuelTypeID 3) for model year 2015

	A	B	C	D	E	F
1	sourceTypeID	modelYearID	fuelTypeID	engTechID	fuelEngFraction	
2	41	2015	2	1	0.5	
3	41	2015	3	1	0.5	
4	42					
5	43					
6	51					
7	52					
8	53					
9	54					
10	61					
11	62					



Proposal for Next Version (cont'd)

3. Apply the current power-based CNG emission rates derived from CNG-fueled transit buses to newly-allowed heavy-duty CNG source types
 - MOVES accounts for the differences in road type VMT distributions, average speed, duty cycles, vehicle weight, road load coefficients between different source types (e.g. long-haul combination truck vs. single-unit short haul)
 - Transit buses and other truck vocations use same technology CNG engines; which is currently dominated by spark-ignited stoichiometric burn with 3-way catalyst



Proposal for Next Version (cont'd)

4. Update the CNG emission rates for 2007+ model year engines based on new certification data
 - In MOVES2014, the CNG base emission rates are based on emissions data from 1994-2004 model year transit buses
 - Used to cover two model year ranges: pre-2001 and 2002-2006
 - MOVES2014 used EPA emissions certification data from 2002-2006 and 2007-2012 model year CNG Urban Buses to scale the emission rates for 2007+ emission rates
 - We now have emissions certification data through model year 2017
 - Includes data for all heavy-duty CNG engines (light heavy-duty, medium heavy-duty, heavy heavy-duty) in addition to urban buses



Proposed CNG emission rates

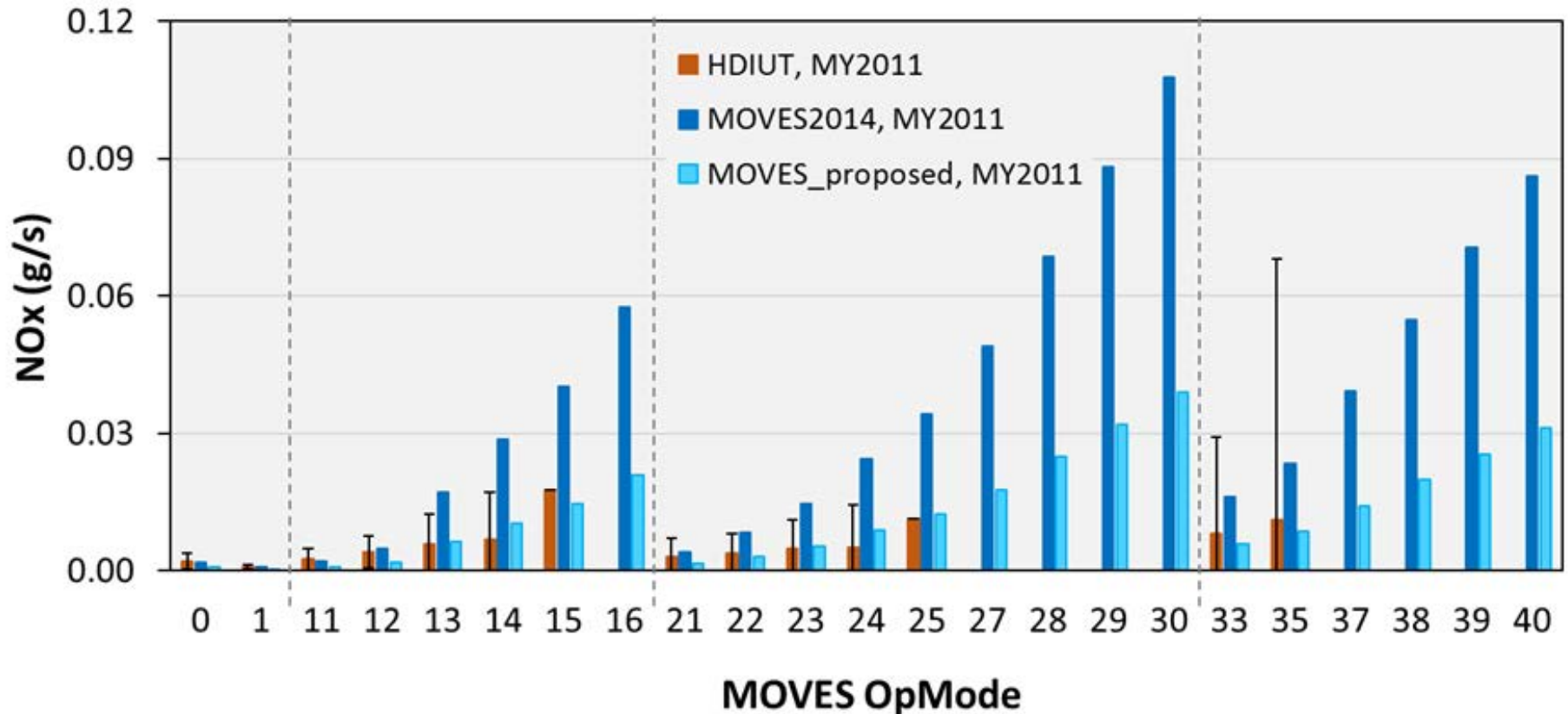
- The 2007-2012 certification data were split in two groups, 2007-2009 and 2010-2017
 - Accounts for the 2010 Heavy-duty NOx standard
- The proposed rates for each model year group are based on ALL CNG heavy-duty data from the EPA certification database, instead of just urban bus

Model Year Group	# of Engine Families	Certification (g/bhp-hr)			
		NOx	CO	PM	NMHC
2002-2006 ✓	25	1.21	1.36	0.0078	0.147
2007-2012 ✗	11	0.29	3.03	0.0033	0.057
2007-2009	30 (24 for PM)	0.61	1.94	0.0042	0.063
2010+	155 (120 for PM)	0.11	4.41	0.0028	0.044



Proposed CNG emission rates

- The proposed CNG emission rates for MY 2010+ compare well with the data from one heavy-duty CNG engine family (MY 2011) available from the Heavy-Duty In-Use Testing database (HDIUT)



QUESTIONS?

