Greenhouse Gas (GHG) Emission Requirements
Combination Tractors and Vocational Vehicles

Industry/EPA/NHTSA Workshop

Washtenaw Community College

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GHG Overview

- Begins with 2014 model year and increases in stringency through 2018 model year
- Breaks diverse truck sector into 3 distinct categories with unique approaches for each
  - Combination tractors
  - Heavy-duty pickups and vans
  - Vocational vehicles (everything else, buses, refuse trucks, concrete mixers, ambulances, etc.)
- Sets separate standards for engines as well as vehicles ensuring improvements in both vehicles and engines
- Sets separate standards for CO_2, N_2O, CH_4 and HFCs
  - NHTSA is setting complementary fuel consumption standards
- Provides incentives for early introduction of GHG-reducing technologies and advanced technologies including EVs and Hybrids
- Provides manufacturer flexibilities including Averaging, Banking and Trading, among other provisions

How Does This Apply to Tractors and Vocational Vehicles?

- Regulations are located at: 40 CFR Part 1037
  - §1037.1 - Applicability
  - §1037.5 – Excluded vehicles
  - §1037.150 – Interim provisions (small manufacturers, EVs, early certification, etc)
  - §1037.801 - Definitions

- Applicable to 2014 and later model year new heavy-duty vocational vehicle chassis and combination tractors
  - Specifically regulates emissions of carbon dioxide
  - Regulates HFC emissions from combination tractors
  - Compliance date: compliance is optional prior to January 1, 2014

- Excluded Vehicles include:
  - Vehicles not meeting definition of “motor vehicle” or “heavy-duty vehicle”
  - Medium-duty passenger vehicles
  - Vehicles produced before 2014 model year, unless certified under §1037.150
  - Vehicles subject to light-duty greenhouse gas standards of 40 CFR part 86
  - Small manufacturers qualifying under Small Business Administration regulations at 13 CFR 121

- This Rule Does Not Regulate Trailers

Timeline for Compliance

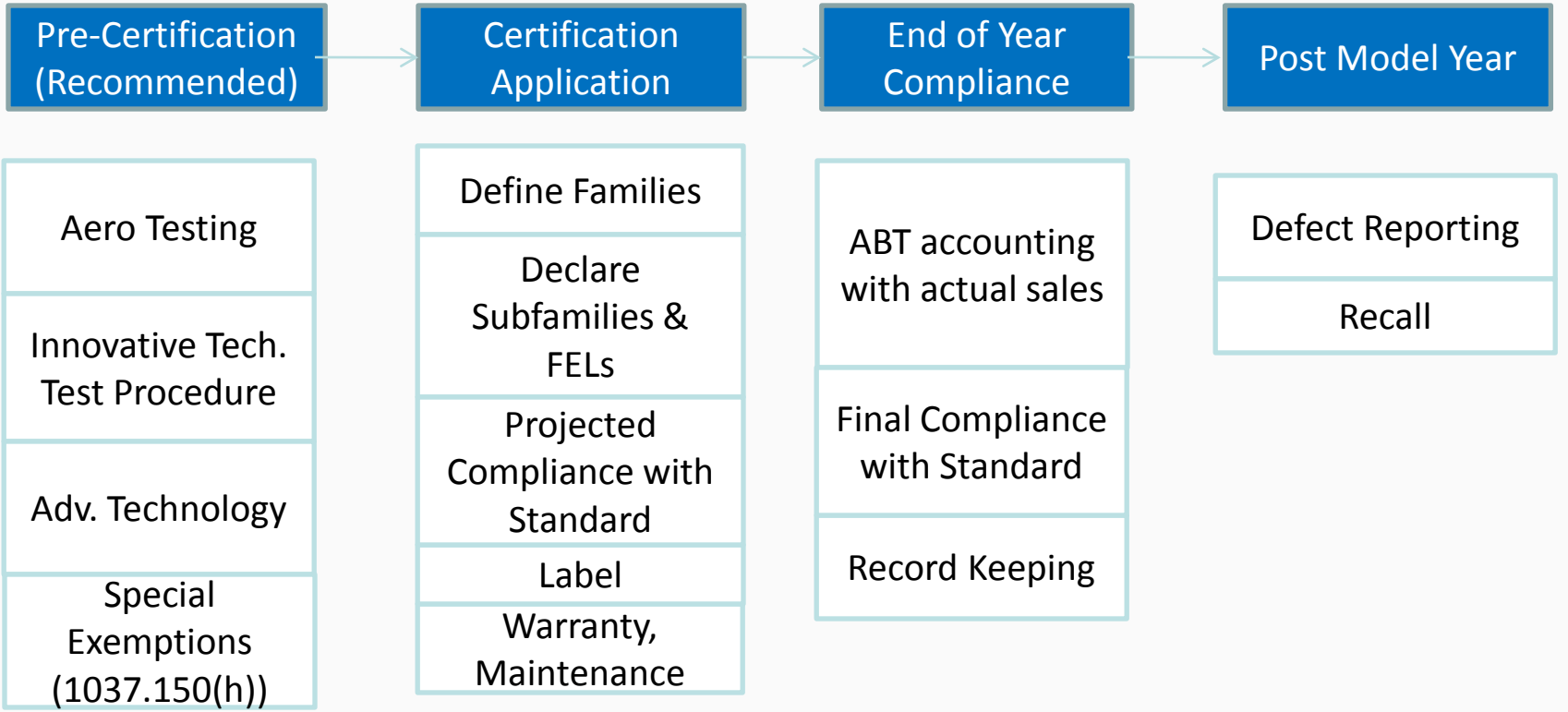
- Now:
  - Approach certification staff with questions about pre-certification testing:
    - Aerodynamic evaluation
    - Tire testing
    - Innovative or advanced technology evaluation
  - Conduct testing, such as:
    - Aerodynamic, tire, “A vs B” vehicle testing, etc
    - See also GEM model discussion starting in Slide 19

- Prior to the beginning of model year (as early as possible):
  - Complete application package, including filling out template and submitting additional support documents
  - If all regulatory requirements are satisfied, EPA will issue a certificate of conformity which allows your vehicle to be entered into US commerce

- 90 days after end of model year:
  - Submit report including production volumes by vehicle and subfamily configuration

- 270 days after end of model year:
  - Submit final report

Certification Process



GHG STANDARDS

Tractor CO_2 Standards

§1037.106

- Each tractor's standard is based on the GVWR and cab attributes of the tractor
  - Class 7 (26,000-33,000) & Class 8 (>33,000)
  - Low, mid, and high-roof configurations
  - Day and sleeper cabs

- The CO_2 standards become more stringent in 2017 model year based on the required improvements in the HD engines. No improvements to the tractor would be necessary to meet these standards.

- You may optionally certify a tractor to the standards and useful life applicable to a higher vehicle service class (such as heavy heavy-duty instead of medium heavy-duty), provided you do not generate credits with the vehicle. If you include smaller vehicles in a credit-generating subfamily (with an FEL below the standard), exclude its production volume from the credit calculation.

GVWR (pounds)	Sub-category	CO_2 Standard (g/ton-mile) for Model Years 2014-2016	CO_2 Standard (g/ton-mile) for Model Year 2017 and later
26,000 < GVWR ≤ 33,000	Low-Roof (all cab styles)	107	104
	Mid-Roof (all cab styles)	119	115
	High-Roof (all cab styles)	124	120
GVWR > 33,000	Low-Roof Day Cab	81	80
	Low-Roof Sleeper Cab	68	66
	Mid-Roof Day Cab	88	86
	Mid-Roof Sleeper Cab	76	73
	High-Roof Day Cab	92	89
	High-Roof Sleeper Cab	75	72

Vocational Vehicle CO_2 Standards

§1037.105

- Each vehicle's standard is based on the GVWR of the complete vehicle
- The CO_2 standards become more stringent in 2017 model year based on the required improvements in the HD engines. No improvements to the tractor would be necessary to meet these standards.
- You may optionally certify a vocational vehicle to the standards and useful life applicable to a higher vehicle service class (such as medium heavy-duty instead of light heavy-duty), provided you do not generate credits with the vehicle. If you include smaller vehicles in a credit-generating subfamily (with an FEL below the standard), exclude its production volume from the credit calculation.

Table 1 to §1037.105—CO_2 Standards for Vocational Vehicles

GVWR (pounds)	CO_2 Standard (g/ton-mile) for Model Years 2014-2016	CO_2 Standard (g/ton-mile) for Model Year 2017 and later
GVWR $\leq$ 19,500	388	373
19,500 < GVWR $\leq$ 33,000	234	225
33,000 < GVWR	226	222

HFC (A/C) Standards for Tractors

§1037.115(c)

- HFC emissions are controlled through a leakage standard and certification is design-based (no system-level testing is required)
- No averaging, banking, or trading of HFC credits is allowed
- The leakage of refrigerant from an A/C system may not exceed 1.50 percent per year
  - For systems with refrigerant capacities less than 734 grams, the leakage may not exceed 11.0 grams per year
- Additional details on determining the HFC leakage rate of A/C systems is included on slide 32
- The air conditioning leakage standard does not apply to vocational vehicles – §1037.150(d)

N_2O and CH_4 Standards

§1036.108 (a), §1037.106(c)

- Standards for N_2O and CH_4 apply to heavy-duty engines
- No unique N_2O or CH_4 emission standards apply to tractors or vocational vehicles; however, must use a GHG-certified engine

Regulation Structure & Requirements

Subcategory	Family	Subfamily	Vehicle Configuration	Vehicle
9 Tractor Subcategories which are based on GVWR, roof height, and cab (day or sleeper)	Typically one family per vehicle subcategory Additional families for vehicles with advanced or innovative technologies	A subfamily is a group of vehicle configurations within a family that have the same FEL The maximum number of GHG subfamilies are determined by the span of whole number g/ton-mile results for the family For instance, if the range of FELs in a family is 300 to 310, there could be up to11 subfamilies (in 1 g/ton-mile increments)	A vehicle configuration is a set of vehicles with the same set of component configurations	Each truck produced is a vehicle with a unique VIN
3 Vocational Vehicle Subcategories which are based on GVWR	**Certification is based on the Family** **-One certification application per family** **-One certificate of conformity issued for each family**	**Each subfamily has its own FEL which becomes the emission standard for every vehicle in the subfamily**	An aero configuration consists of similar body components with the same aero bin and a similar C_dA A tire configuration consists of a single tire model A weight configuration consists of the same set of weight reduction technologies An AES configuration consists of a single shutdown strategy, including expiration setting A VSL configuration consists of a single VSL setting, including expiration and soft top settings **Each configuration listed in GEM input/output**	**Each vehicle has its own ECI label** **Record keeping is required for each vehicle** **In-use, Audit** **Recall**
The Subcategory determines the CO_2 emission standard				

CERTIFICATION

Certification Requirements

§1037.201

- Each vehicle family is required to be certified prior to introduction into US commerce
  - A certificate of conformity, or “certificate” is issued as evidence of this
- The certificate is valid from the effective date until the end of the model year for which it is issued.
  - A model year must include January 1 of the calendar year for which the model year is named and may not begin before January 2 of the previous calendar year, and it must end by December 31 of the named calendar year – §1037.801
- The certificate must be renewed annually for vehicles you continue to produce

Demonstrating Compliance with CO_2 Emission Standards

- Manufacturers must calculate a projected production-weighted average CO_2 performance for each family based on the modeled (GEM) results from at least ten subfamilies
  - Where production means “U.S.-directed production volume for which the manufacturer has a reasonable assurance that sale was or will be made to ultimate purchasers in the United States”

- The projected production-weighted CO_2 average (including credits) must meet applicable subcategory standard
  - ABT, Early, and Innovative Credits may be averaged within an Averaging Set. The three averaging sets are:
    - Light Heavy-Duty Vehicles (Cl. 2b-5)
    - Medium Heavy-Duty Vehicles (Cl. 6-7)
    - Heavy Heavy-Duty Vehicles (Cl. 8)
  - Advanced Technology Credits may cross over averaging sets, but have a restriction in number of credits that can cross service classes
  - May carry forward credits for 5 subsequent model years
  - May carry forward a deficit for 2 subsequent model years (3 model years total)

Useful Life Compliance

Deterioration Factors - §1037.241

- For purposes of certification, the vehicle family is considered in compliance with the emission standards if all vehicle configurations in that family have modeled CO_2 emission rates at or below the applicable standards. In other words, zero deterioration is assumed.
  - Refer to Slides 19-31 for information on how the "modeled CO_2 emission rates" are developed

- If we determine that your emission controls are likely to deteriorate during the useful life, we may require you to develop and apply deterioration factors consistent with good engineering judgment.
  - For example, you may need to apply a deterioration factor to address deterioration of battery performance for an electric hybrid vehicle.
  - Where the highest useful life emissions occur between the end of useful life and at the low-hour test point, base deterioration factors for the vehicles on the difference between (or ratio of) the point at which the highest emissions occur and the low-hour test point.

Certification Process Outline

- Obtain manufacturer code & CDX access (described earlier)
- Pre-application
  - Define vehicle families, subfamilies, and configurations
  - Conduct aerodynamic evaluation, collect tire data, other testing
  - Determine other GEM inputs (VSL, AES, weight reduction)
  - Conduct GEM modeling of your subfamilies
- Application
  - Fill out and submit the certification template
  - Submit supplemental documents
- Review
  - EPA certification staff will review your materials
  - We will work with you to resolve any outstanding issues
- Certification
  - If all regulatory requirements are satisfied, we will issue a certificate of conformity, allowing your vehicle family to be introduced into US commerce

➢ *At all steps, we encourage you to work with your EPA certification representative to avoid surprises or delays in the process*

Pre-Certification: Selecting Vehicle Families
§1037.230

- Families are defined by:
  - Regulatory subcategory
    - Weight class
    - Vocational or tractor
    - Cab configuration (tractors only)
  - Advanced technology
  - Innovative technology

- Generally, there will be one family per subcategory of conventional vehicles (i.e. non-advanced or innovative tech)

- Families are identified with a 12-digit name
  - Include model year and manufacturer code
  - Separate guidance will be issued on naming guidelines

Pre-Certification: GEM Inputs
§1037.520

- Subfamily CO_2 emission levels will be determined through a model (GEM) requiring inputs such as:
  - Aerodynamic bin (tractors only)
  - Tire rolling resistance
  - Automatic engine shutdown features (AES, class 8 sleeper cabs only)
  - Vehicle speed limiter features (VSL, tractors only)
    - VSL is not a mandated input, and need only be provided if manufacturer includes it. See Slide 26 for further detail
  - Weight reduction technologies (tractors only)
- You will likely need to test your vehicle to determine some of the inputs. This testing will need to be done in advance
  - Aerodynamics
  - Tire rolling resistance

Pre-Certification: Aerodynamics

§1037.521

- Drag area (C_dA) is used for classifying tractors into aerodynamic bins
  - The C_d of the bin is used as the GEM input. For example:

High-Roof Sleeper Cabs		
Bin Level	If your measured C_DA (m^2) is . . .	Then your C_D input is . . .
Bin I	≥ 7.6	0.75
Bin II	6.7-7.5	0.68
Bin III	5.8-6.6	0.60
Bin IV	5.2-5.7	0.52
Bin V	≤ 5.1	0.47

- The recommended method for determining C_dA is coastdown testing (§1037.521(b))
  - Manufacturers may use alternate methods (CFD, wind-tunnel, etc), however preliminary approval must be granted by EPA prior to using such methods (§1037.521(c))
  - If an approved alternative method is used, an adjustment factor ($F_{alt\text{-}aero}$) is applied to normalize the results to coastdown testing

Pre-Certification: Aerodynamics

Alternative Methods

- Basic outline for using alternate aerodynamic evaluation methods
  - Approach your EPA certification representative with your plan for validating the alternate method, including all the elements listed in §1037.521(c)(2),(3),&(4)
  - Conduct coastdown testing using a CI-8, high-roof, sleeper cab with full aerodynamics package, pulling a standard trailer
    - Unless we approve otherwise
    - If you have multiple vehicles meeting this description, use the one with highest projected sales
  - Conduct testing of the same vehicle using the alternate method
    - Calculate the adjustment factor ($F_{alt\text{-}aero}$) using these two tests
  - Present the final results to EPA certification staff for approval
  - Approval will include the conditions under which this is valid (e.g. wind tunnel boundary layer treatment, CFD turbulence treatment, etc.)

Pre-Certification: Aerodynamics

Example – High-Roof Tractor

- A coastdown of high-roof sleeper cab #1 produced a C_dA test result of 6.2 m^2
- The same high roof sleeper cab #1 was tested in a wind tunnel and produced a C_dA test result of 6.3 m^2
- $F_{alt\text{-}aero}$ for this manufacturer's wind tunnel is equal to 6.2 / 6.3 = 0.984
- High roof sleeper cab #2 is tested in the same wind tunnel and produces a C_dA of 5.8 m^2
- The C_dA value for #2 is equal to 5.8 * 0.984 = 5.7 m^2
- Tractor #2 falls into Bin IV and a C_d value of 0.52 is entered into GEM

High-Roof Sleeper Cabs		
Bin Level	If your measured C_DA (m^2) is . . .	Then your C_D input is . . .
Bin I	≥ 7.6	0.75
Bin II	6.7-7.5	0.68
Bin III	5.8-6.6	0.60
Bin IV	5.2-5.7	0.52
Bin V	≤ 5.1	0.47

Pre-Certification: Aerodynamics

Provisions for low & mid-roof tractors

- Manufacturers may use the drag area from a high-roof tractor to certify low and mid-roof tractors (§1037.520(b)(3))

- Under this provision, apply the following conversion:

If your high-roof bin is:	Your low or mid-roof bin is:
I or II	I
III, IV, or V	II

- Example:
  - Your CI-8, high-roof day-cab "config. A" was tested and determined to have a C_dA of 6.6 m^2
    - The appropriate aerodynamic bin is bin III (§1037.520(b)(2)) and therefore has a GEM C_d input of 0.63
  - You wish to certify your CI-8 low-roof day-cab "conf. Z" using these aerodynamic results
    - Based on §1037.520(b)(3), your aerodynamic is bin II and your GEM C_d input is 0.71

Pre-Certification: Tire Testing
§1037.520(c)

- GEM input is equal to the average rolling resistance of 3 tires, measured once each using ISO 28580 test procedure
- Manufacturers may conduct tire testing or use data from tire manufacturers
  - If results are obtained from a third party, a signed statement from the third party must be obtained (§1037.520(c)(3))
- Reference testing laboratories:
  - Standard Testing Lab (STL), Massillon, OH – www.stllabs.com
  - Smithers-Rapra (Smithers), Ravenna, OH – www.smithers.com

Pre-Certification: Other GEM Inputs

- Weight reduction 1037.520(e)
  - Determine the total weight reduction based on the components installed in the vehicle as indicated in Table 4 and Table 5 to §1037.520

Weight Reduction Technology		Weight Reduction (lb per tire or wheel)
Single-Wide Drive Tire with . . .	Steel Wheel	84
	Aluminum Wheel	139
	Light-Weight Aluminum Wheel	147
Steer Tire or Dual-wide Drive Tire with . . .	High-Strength Steel Wheel	8
	Aluminum Wheel	21
	Light-Weight Aluminum Wheel	30

Weight Reduction Technologies	Aluminum Weight Reduction (lb)	High-Strength Steel Weight Reduction (lb)
Door	20	6
Roof	60	18
Cab rear wall	49	16
Cab floor	56	18

Pre-Certification: Other GEM Inputs

- Vehicle Speed Limiter (VSL) §1037.520(d), §1037.640
  - Enter speed limit to nearest 0.1 mph
  - For systems which are equipped with either an expiring VSL or soft-top, derive input per the following equation – §1037.640(d)
    - Effective speed = ExF * [STF* STSL + (1-STF) * DSL] + (1-ExF)*65 mph
    - Where:
      - ExF = Expiration factor
      - STF = Maximum number of soft-top operation hours/day
      - STSL = Soft top speed limit
      - DSL = Default speed limit
  - At the time of certification, please identify the VSL parameters resulting in the highest GEM input, lowest GEM input, and highest projected sales within a given family

- Extended idle reduction (AES) §1037.520(f), §1037.660
  - If equipped with automatic engine shutdown after 5 minutes of idling, use 5 g/ton-mile
  - Allowable delays and override conditions are listed in §1037.660(a) and (b)
  - For systems which are equipped with an expiring automatic engine shutdown, derive input per the following equation, and input the value rounded to one decimal place - 1037.660(c)
    - Input = 5 g CO_2/ton-mile × (miles at expiration / 1,259,000 miles)
  - At the time of certification, please identify the AES parameters you intend to use resulting in the highest GEM input, lowest GEM input, and highest projected sales within a given family

GEM Simulation Tool v2.0

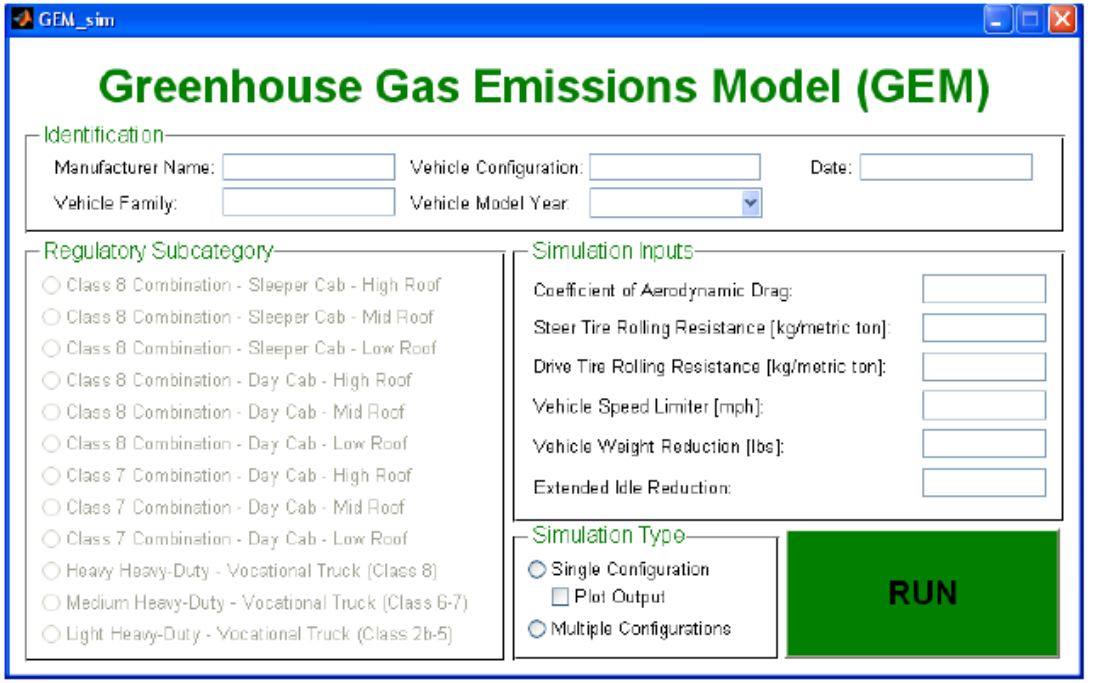
- GEM is available at:
  - http://www.epa.gov/otaq/climate/gem.htm

- Download the executable version of GEM Setup.exe
  - Will create executable file on desktop
  - Creates GEM folder which contains:
    - GEM User Manual
    - Sample GEM input file
    - GEM Executable file

- Refer to User Guide for installation and use instructions

- Batch-processing input file (Excel-based) included

GEM GUI



- Select Simulation Type (Single or Multiple Configuration)
- For Single Configuration Run:
  - Input Identification information
  - Select one regulatory subcategory
  - Input Simulation Inputs information
  - “Run”

GEM Input File Example

For running one or more vehicle configurations

Manufacturer Name	XXX
Model Year	2014
Vehicle Family Name	XXX
Regulatory Subcategory	Class 8 Combination - Sleeper Cab - High Roof
Input File Name	GEM_Input

	EPA Defined
	User Entered
	GEM Input

		Aerodynamics			Steer Tires	Drive Tires			
Configuration	**Brand/Model Name**	**Bin**	**CdA (Test)**	**Cd (Bin)**	**CRR**	**CRR**	**Idle Reduction**	**Weight Reduction**	**VSL**
1		II	6.8	0.68	7.8	8.2	0	0	65
2		III	6.5	0.60	7.8	8.2	0	0	65
3		IV	5.7	0.52	7.8	8.2	0	0	65
4		II	7	0.68	7.8	7.3	0	0	65
5		III	5.9	0.60	7.8	8.2	0	400	65
6		IV	5.6	0.52	7.8	7.3	0	400	65

GEM Output File Example

Manufacturer Name	XXX
Model Year	2014
Vehicle Family Name	XXX
Regulatory Subcategory	Class 8 Combination - Sleeper Cab - High Roof
Date/Time of Run	19-Aug-2011/02:58:00pm
Input File Name	N/A

	Passed through from input matrix
	GEM Inputs (from input matrix)
	GEM Outputs
	User Input following GEM run

		Aerodynamics			*Steer Tires*	*Drive Tires*				*Results*		*FEL*		*Subfamily*		
Configuration	**Brand/Model Name**	**Bin**	**CdA (Test)**	**Cd (Bin)**	**CRR**	**CRR**	**Idle Reduction**	**Weight Reduction**	**VSL**	**g CO2/ton-mile**	**gal/1000 ton-mile**	**g CO2/ton-mile**	**gal/1000 ton-mile**	**Subfamily Name**	**Subfamily FEL**	**Subfamily Volume**
1	N/A	III	6.5	0.65	7.8	8.2	0	0	65	87.09933	8.55592	87	8.6			

GEM Results Required for Certification
§1037.520

- Run GEM for a minimum of ten vehicle configurations for each family, including:
  - Highest modeling result
  - Lowest modeling result
  - Highest projected sales
- List an FEL for each potential subfamily within the family
  - This will be each whole number gram/ton-mile value between the lowest and highest modeling result from above
- Please include your GEM input/output file in your application for certification

HFC Emissions

§1037.115(c)

- An excel file is available to calculate percent leakage and leakage rate of HFC emissions

1. RIGID PIPE CONNECTIONS

Enter the number of each type of fitti

Type of connection	
Single O ring:	
Single captured O ring:	
Multiple O ring:	
Seal washer:	
Seal washer with O ring:	
Metal gasket:	
Rigid pipe connections emission	

2. SERVICE PORTS AND REFRIGERAI

Enter the number of each type of por

Type of connection	
High side service ports:	
Low side service ports:	
Switches, transducers, and press	
Refrigerant control devices:	
Service port/control device emiss	

3. FLEXIBLE HOSES

Enter the dimensions for each hose, by hose type, in the system.

All Rubber Hose	
	High pressure side, hose 1
	High pressure side, hose 2
	High pressure side, hose 3
	High pressure side, hose 4
	Low pressure side, hose 1
	Low pressure side, hose 2
	Low pressure side, hose 3
	Low pressure side, hose 4
Standard barrier or veneer hose	
	High pressure side, hose 1
	High pressure side, hose 2
	High pressure side, hose 3
	High pressure side, hose 4
	Low pressure side, hose 1
	Low pressure side, hose 2
	Low pressure side, hose 3
	Low pressure side, hose 4
Ultra-low permeation barrier or veneer	
	High pressure side, hose 1
	High pressure side, hose 2
	High pressure side, hose 3
	High pressure side, hose 4
	Low pressure side, hose 1
	Low pressure side, hose 2
	Low pressure side, hose 3
	Low pressure side, hose 4

4. HEAT EXCHANGERS, MUFFLERS, RECEIVER/DRIERS, AND ACCUMULATORS

Emission rate for all devices combined assumed to be 0.5 x 0.522.

Emission rate for all devices (g/year):	0.261

5. COMPRESSORS

Enter the number of each type of fitting in the appropriate cell below:

Type of Fitting	No.
O-ring housing seals:	1
Molded housing seals:	1
Fitting adapter plates:	1
Gasket housing seals:	
Lips on shaft seal (belt-driven compressors only):	1
Compressor emission rate (g/year):	11.223

6. REFRIGERANT CAPACITY FOR SYSTEMS WITH GREATER THAN 733 GRAMS

Enter the system's refrigerant capacity in grams in the appropriate cell below:

Refrigerant Capacity (g)	1300

FOR REFRIGERANT CAPACITY FOR SYSTEMS WITH LESS THAN OR EQUAL TO 733 GRAMS

TOTAL SYSTEM REFRIGERANT EMISSION RATE (G/YEAR):	**19.2**

FOR REFRIGERANT CAPACITY FOR SYSTEMS WITH GREATER THAN 733 GRAMS

TOTAL SYSTEM REFRIGERANT PERCENT LEAKAGE (%/YEAR):	**1.5%**

HD Vehicle GHG Certification Template

- Excel-based template designed to collect most information required in §1037.205
  - General family information
  - Advanced/innovative technology basics
  - HFC information
  - GEM input/output

- Remainder of information is collected in supplemental documents
  - ECI Label
  - Warranty document
  - Aerodynamics worksheet
  - Other

- All information will be uploaded to EPA's CDX system

➢ ***Demonstration of template***

Application: Supplemental Documents

Labeling -§1037.135

- §1037.135 Requires your vehicles to have a permanent emission-control information label

Provide sample of vehicle label with the following information:

- Heading: "VEHICLE EMISSION CONTROL INFORMATION"
- Corporate name and trademark
- Vehicle family standardized designation (to be provided in guidance)
- Regulatory subcategory
- Date of manufacture
- Emission Control System (identifiers shown in App III to Part1037)
- Fuel and lubricant requirements
- Statement "THIS VEHICLE COMPLIES WITH U.S. EPA REGULATIONS FOR [MODEL YEAR] HEAVY-DUTY VEHICLES"

Application: Supplemental Documents

Warranty - §1037.120

- For purposes of application for certification, include a copy of the warranty statement provided to consumers
- The general requirement is that the product is designed and built so it conforms a the time of sale with GHG requirements
- Warranty periods, at least:
  - Spark-ignition vehicles and light heavy-duty vehicles: 5 years or 50,000 miles
  - Medium and heavy heavy-duty vehicles: 5 years or 100,000 miles
  - Tires: 2 years or 24,000 miles
  - Warranty period cannot be shorter than any warranty of a component that you provide without charge
- Components covered include all components whose failure would increase a vehicle's GHG emissions, including:
  - For Tractors: VSL, idle shutdown systems, fairings, hybrid components, tires, air conditioning components, and other advanced and innovative technology components
  - For Vocational Vehicles: hybrid components, tires, and other advanced and innovative technology components
- Describe the emission-related warranty provisions in the owners manual

Application: Supplemental Documents

Maintenance - §1037.125

- For purposes of application for certification of conventional vehicles, include a statement that says you meet the maintenance requirements of this part. For advanced technology vehicles, provide a copy of maintenance instructions provided to the consumer.

- Critical emission-related maintenance
  - You may schedule critical emission-related maintenance on these components if you demonstrate that the maintenance is reasonably likely to be done at the recommended intervals on in-use vehicles.
  - You may recommend any additional amount of maintenance on these components as long as you state clearly that these maintenance steps are not necessary to keep the emission-related warranty valid.

- See regulations for other special maintenance, noncritical emission-related maintenance, and non emission-related maintenance

- Explain the owner's responsibility for proper maintenance in the owners manual.
  - Include instructions that will enable the owner to replace tires so that the vehicle conforms to the original certified vehicle configuration.

- See §1037.220 for amending maintenance instructions

Application: Supplemental Documents

Aerodynamics - §1037.520(b)

Two types of aerodynamic worksheets:

- Alternate aerodynamic method approval
  - May be used across several vehicle families
  - Describes the alternate method and how testing must be conducted for the approval to be valid
  - Described on “alternative methods” slide
- Aerodynamic testing
  - Test vehicle and test method descriptions
  - Methodology for aerodynamic configuration grouping
  - Test results from vehicles within the family
  - Aerodynamic bin(s) for each configuration
- Currently no standardized template/format for either
  - Please consult §1037.520 & §1037.521 for the required content

GHG Program Flexibilities

Vocational Tractors – §1037.630:

- Allows manufacturers to reclassify certain tractors essentially as vocational vehicles, such as:
  - Low roof pickup and delivery
  - Off-road operation such as reinforced frames and increased ground clearance
  - GCWR>120,000 pounds
- Must conform to applicable vocational vehicle requirements instead of tractor requirements
- Provide explanation of why specific tractor qualifies as a vocational tractor in application
- Report VINs in end of the year report that fall under this provision
- Special Label required - §1037.630(b)(3)

Restrictions:

- Limited to 21,000 tractors in any three model year period per manufacturer

Off-Road Vehicles – §1037.631:

- Applies to vocational tractors and vocational vehicles intended for off-road use, such as vehicles that:
  - Tires rated at 55 mph or lower
  - Designed for low speed operation
  - GAWR>29,000 pounds
  - Speed attainable in 2 miles of not more than 33 mph
  - Speed attainable in 2 miles of 45 mph and an unloaded vehicle weight not less than 95% of its GVWR, and no capacity to carry occupants other than driver and crew
- Off-road vehicles do not have any vehicle requirements
- Provide explanation of why specific tractor qualifies as a off-road vehicle in application
- Report VINs in end of the year report that fall under this provision
- Special Label required - §1037.631(d)
- §1037.150(h): In unusual circumstances, manufacturers may ask us to exempt vehicles under §1037.631 based on other criteria that are equivalent to those specified in §1037.631(a). For example, we would normally not grant relief in cases where the vehicle manufacturer had credits or other compliant tires were available.

➢ ***In either case, work with your certification representative to confirm your vehicle qualifies***

Vocational Vehicle Program Flexibility

§1037.150(l)

Optional certification to the standards of §1037.104

- You may certify certain complete or cab-complete vehicles to the standards of §1037.104 (HD Pickup Truck and Van standards), such as:
  - Complete or cab-complete spark-ignition vehicles
  - Cab-complete vehicles based on a complete sister vehicle
  - In unusual circumstances Class 2b or 3 incomplete vehicles

Restrictions:

- Does not affect criteria pollutant certification

Optional HD Chassis-Certification

Class 4 and Above Vehicles - §1037.150(l)

		Classes greater than Class 3		Loose engines (for any HD vehicle class)	
Spark-ignition	Criteria	E		E	
	GHG	C	E	C	E
Diesel	Criteria	E		E	
	GHG				

E = engine-certified (g/hp-hr) for criteria pollutants and treated as a vocational vehicle for GHG with separate engine certification (g/hp-hr) and vehicle certification with GEM (g/ton-mile)

C = chassis-certified (g/mile)

C or **E** = manufacturer can choose between chassis-certification and engine-certification

- Spark Ignition and Diesel vehicles must engine certify for criteria emissions

- Diesel vehicles must:
  - Certify as a vocational vehicle for GHG emissions with separate engine certification and vehicle certification

- Spark ignition vehicles may choose to either:
  - Chassis certify for GHG emissions (2014MY and later) –or –
  - Certify as a vocational vehicle for GHG emissions with separate engine certification (2016MY and later) and vehicle certification (2014MY and later)

CREDITS

Earning CO_2 Credits

§1037.705, et al.

Sum of four independent calculations (calculated separately for each averaging set) = total credits in a model year

1. Averaging, Banking, and Trading – §1037.705
2. Early Credits – §1037.150(a)
3. Innovative Technology Credits – §1037.610
4. Advanced Technology Credits – §1037.615

Credits are rounded to the nearest whole megagrams (Mg) after the intermediate calculations

Credit Applicability

Subcategory

Standards are based on Subcategory

9 Tractor Subcategories
- Cl. 7 Low Roof Day Cab
- Cl. 7 Mid Roof Day Cab
- Cl. 7 High Roof Day Cab
- Cl. 8 Low Roof Day Cab
- Cl. 8 Mid Roof Day Cab
- Cl. 8 High Roof Day Cab
- Cl. 8 Low Roof Sleeper Cab
- Cl. 8 Mid Roof Sleeper Cab
- Cl. 8 High Roof Sleeper Cab

3 Vocational Vehicle Subcategories
- Light Heavy –Duty Vehicles (Cl. 2b-5)
- Medium Heavy-Duty Vehicles (Cl. 6-7)
- Heavy Heavy-Duty Vehicles (Cl. 8)

4 Engine Subcategories
- Light Heavy-Duty CI Engines (Cl. 2b-5)
- Medium Heavy-Duty CI Engines (Cl. 6-7)
- Heavy Heavy-Duty CI Engines(Cl. 8)
- Spark Ignited Engines

Averaging Set

ABT, Early, and Innovative Credits must stay within an Averaging Set

3 Vehicle Averaging Sets
- Light Heavy –Duty Vehicles (Cl. 2b-5)
- Medium Heavy-Duty Vehicles (Cl. 6-7)
- Heavy Heavy-Duty Vehicles (Cl. 8)

4 Engine Averaging Sets
- Light Heavy-Duty CI Engines (Cl. 2b-5)
- Medium Heavy-Duty CI Engines (Cl. 6-7)
- Heavy Heavy-Duty CI Engines(Cl. 8)
- Spark Ignited Engines

Service Class

Advanced Technology credits may move among averaging sets, but moves from one service class to another are restricted to 60,000 Mg per model year

3 Service Classes
- SI Engines, Light Heavy –Duty Vehicles and CI Engines (Cl. 2b-5)
- Medium Heavy-Duty Vehicles and CI Engines (Cl. 6-7)
- Heavy Heavy-Duty Vehicles and CI Engines (Cl. 8)

GHG Credit Programs

Early Credits – §1037.150(a):
- 2013 MY only
  - All Pre-2014 MY EVs
- 1.5x multiplier
- Certify entire regulatory subcategory

-or-

- Difference between 2012 MY and 2013 MY SmartWay designated high roof sleeper cab sales

Restrictions:
- Credits stay in averaging set – §1037.740(a)
- 5 year credit life - §1037.740(c)
- Only a single 1.5x multiplier may be used for early credits which are also eligible for Advanced Technology Credits - §1037.150(i)

Advanced Technology Credits – §1037.615:
- Vehicles equipped with:
  - Hybrid powertrain with regenerative braking
  - Rankine cycle engines
  - Electric vehicles
  - Fuel cell vehicles
- Only a vehicle OR engine manufacturer (not both) may certify and claim credits for an advanced technology
- 1.5x multiplier – 1037.150(i)

Restrictions:
- Credits can go into any averaging set, except only 60,000 Mg CO_2 credits per model year can come into a service class from another service class - §1037.740(b)
- 5 year credit life – §1037.740(c)

Innovative Technology Credits – §1037.610:
- Vehicle or engine technology which is not captured on test (GEM) and not in common use in 2010 MY for heavy-duty vehicles
- Preapproval of test method required
- No multiplier

Restrictions:
- Credits stay in averaging set – §1037.740(a)
- 5 year credit life – §1037.740(c)

Advanced Technology Demonstration

§1037.510, §1037.525, §1037.550, §1066

- The testing consists of both a conventional vehicle and a hybrid vehicle. The results from the two vehicles will be used to determine an improvement factor
- Advanced technology demonstrations for vehicles with hybrid powertrains would typically occur through either chassis testing or powerpack testing
- Chassis testing
  - Refer to procedures in §1037.510, including the weighting factors for the duty cycles
  - Provisions for vehicles with a power take-off (PTO) are included in §1037.525
- Powerpack testing
  - Refer to procedures in §1037.550

Innovative Technology Credits

§1037.610

- Credits for CO_2-reducing technologies where CO_2 reduction is not captured in the test procedures, e.g., off-cycle
- Subject to EPA & NHTSA approval, technology must:
  - Not be in common use with HD vehicles prior to 2010 MY
  - Not be reflected in GEM
  - Be effective for full useful life and deterioration – if any – must be accounted for
- Ways to quantify reductions
  - Alternative demonstration (EPA approval required)
    - Use chassis testing, modeling, on-road testing/data collection, etc.
    - Be robust and verifiable
    - Demonstrate baseline and controlled emissions over a ***wide range*** of vehicles and driving conditions, minimizing uncertainty
    - May be subject to notice and comment through Federal Register notice

Credit Banking

§1037.715

- Credits are earned at the end of the model year and maintained and reported separately
- Total credits in each category is the sum of:
  - Average credits
  - Optional credits (Innovative, Advanced Technology, Early)
- Credits may be banked for five years after model year in which they were earned
  - Example: Credits earned in 2014 may be used in any of the 2015 through 2019 model years. Credits remaining unused at end of 2019 will expire.
- Banked credits retain the designation of the averaging set in which they were generated, unless they are an Advanced Technology credit

Credit Trading

§1037.720

- Credits may be traded to another manufacturer (or any other party)
  - Annual report must provide details of transfers
  - Trades must involve credits that are available (either generated or purchased by the trader) and must not result in a deficit
  - Traded credits retain the designation of averaging set in which they were generated

- Important! If a manufacturer generates credits, they must use those credits to offset any existing deficit before considering banking or trading

Credit Deficits

§1037.745

- Like positive balances, deficits are determined at the end of the model year and maintained/reported
- Deficits may be carried forward into the three model years after the year generated
  - Example: A deficit accrued in MY2014 may be carried forward through MY2017. If not offset by end of MY2017 then penalties may apply.
- May only apply surplus credits to the deficit
- May be carried forward only after all banked credits are used up
- Certificates may be voided *ab initio* if a deficit is not offset – by credits generated or purchased – by the required model year

REPORTING

Compliance Information

- EPA is committed to both protecting CBI and to achieving transparency in implementation of the GHG program
- EPA currently publishes:
  - Compliance Report
  - Certification data (certification testing summary)
- EPA does not consider emissions data to be CBI, as such the GEM outputs will not be treated as CBI
- For GHG, EPA intends to publish as much non-CBI information for each manufacturer after the end of the model year as possible

End of Year Report

§1037.250

- The end of year report must be submitted within 90 days after the end of the model year and include the following information:
  - Manufacturer corporate name and corporate ownership structure
  - Report production volumes by VIN and vehicle configuration and identify subfamily
  - Report uncertified vehicles sold to secondary vehicle manufacturers
  - Manufacturer average CO_2 performance by subcategory
  - All intermediate calculation values
  - Description of the A/C system, the A/C leakage information (tractors only)
  - Number of credits or debits
  - All intermediate credit/debit values
  - Resultant credit/debit balance
  - Manufacturers who traded credits must include a copy of the transaction documentation, including the name of credit provider, the name of credit recipient, the date of trade, the quantity of megagrams traded, and the model year in which credits were earned.

End of Year Report

Manufacturer Name	
Model Year	2014
Vehicle Family Name	
Regulatory Subcategory	Class 8 Combination - Sleeper Cab - High Roof

DRAFT

		Aerodynamics			*Steer Tires*	*Drive Tires*				*FEL*		*Subfamily*		
VIN	**Brand/Model Name**	**Bin**	**CdA (Test)**	**Cd (Bin)**	**CRR**	**CRR**	**Idle Reduction**	**Weight Reduction**	**VSL**	**g CO2/ton-mile**	**gal/1000 ton-mile**	**Subfamily Name**	**Subfamily FEL**	**Subfamily Volume**
XXXXXXXX1	XXX													
XXXXXXXX2	XXX													
XXXXXXXX3	XXX													
XXXXXXXX4	XXX													
XXXXXXXX5	XXX													
XXXXXXXX6	XXX													
XXXXXXXX7	XXX													
XXXXXXXX8	XXX													
XXXXXXXX9	XXX													
XXXXXXXX10	XXX													
XXXXXXXX11	XXX													
XXXXXXXX12	XXX													
XXXXXXXX13	XXX													
XXXXXXXX14	XXX													

DRAFT

End of Year Report

Credit Summary

Example End of Year Report - Banking and Trading Credits Summary

Vehicle Subcategory	Model Year	Applicable Standard (g/ton-mile)	Manufacturer Compliance Level (g/ton-mile)	Credit (Deficit) (Mg)	Early Credits (Mg)	Innovative Technology Credits (Mg)	Credit Balance Restricted to Averaging Set (Mg)	Advanced Technology Credits (Mg)	Credit Balance Available to Other Averaging Sets (Mg)	Date Credits Were Earned	Comments
Cl. 8 High Roof Sleeper Cab	2014	75	74	10,000	0	5,000	15,000	0	0	12/31/2014	
Cl. 8 Mid Roof Sleeper Cab	2014	76	76	0	0	8,000	8,000	0	0	12/31/2014	
Cl. 8 High Roof Day Cab	2014	92	93	-11,000	0	12,000	1,000	10,000	10,000	12/31/2014	

Certification Contacts for HD engines, tractors & vocational vehicles

- Justin Greuel – DECC Director (DCO)
  - Greuel.justin@epa.gov – (202) 343-9891
- Greg Orehowsky – Team leader
  - Orehowsky.greg@epa.gov – (202) 343-9292
  - Navistar/International, Fiat Powertrain, Mitsubishi Fuso
- Jason Gumbs – Certification representative
  - Gumbs.jason@epa.gov – (202) 343-9271
  - Detroit Diesel/Daimler Trucks, Volvo (P/T & trucks)
- Jay Smith – Certification representative
  - Smith.jay@epa.gov – (734) 214-4302
  - PACCAR, Ford, GM, Cummins, Isuzu

➢ *Manufacturers new to certification should contact Greg*

Future Guidance

- EPA will issue guidance on future subjects when and if necessary
- Please use the index cards to submit questions
- Contact your certification representative

For More Information:

- A copy of this presentation & GHG rulemaking documents will be available at:
  - www.epa.gov/otaq/climate/regulations.htm
- Vehicle certification template will be available at:
  - www.epa.gov/otaq/certdat2.htm
- See Federal Register, 76 FR at 57106 (September 15, 2011)
- See Code of Federal Regulations, 40 CFR Part 1037

APPENDIX

Vehicle Label – Emission Control Information

§1037.135, Appendix III to part 1037

Tractors

- Vehicle Speed Limiters
  - VSL – Vehicle speed limiter
  - VSLS – "Soft-top" vehicle speed limiter
  - VSLE – Expiring vehicle speed limiter
  - VSLD – Vehicle speed limiter with both "soft-top" and expiration
- Idle Reduction Technology
  - IRT5 – Engine shutoff after 5 minutes or less of idling
  - IRTE – Expiring engine shutoff
- Tires
  - LRRA – Low rolling resistance tires (all)
  - LRRD – Low rolling resistance tires (drive RR<8.2)
  - LRRS – Low rolling resistance tires (steer RR<7.8)
- Aerodynamic Components
  - ATS – Aerodynamic side skirt and/or fuel tank fairing
  - ARF – Aerodynamic roof fairing
  - ARFR – Adjustable height aerodynamic roof fairing
  - TGR – Gap reducing fairing (tractor to trailer gap)
- Other Components
  - ADVH – Vehicle includes advanced hybrid technology components
  - ADVO – Vehicle includes other advanced technology components (*i.e., non-hybrid system)*
  - INV – Vehicle includes innovative technology components

Vocational Vehicles

- Tires
  - LRRA – Low rolling resistance tires (all)
  - LRRD – Low rolling resistance tires (drive RR<7.7)
  - LRRS – Low rolling resistance tires (steer RR<7.7)
- Other Components
  - ADVH – Vehicle includes advanced hybrid technology components
  - ADVO – Vehicle includes other advanced technology components (*i.e., non-hybrid system)*
  - INV – Vehicle includes innovative technology components

Small Manufacturer Provisions
§1037.150(c)

- Manufacturers meeting the small business criteria specified in 13 CFR 121.201 for “Heavy Duty Truck Manufacturing” are not subject to the greenhouse gas standards
  - NAICS Code 336120: 1,000 employees
- Qualifying manufacturers must notify the Designated Compliance Officer each model year before introducing these excluded vehicles into U.S. commerce. This notification must include a description of the manufacturer’s qualification as a small business under 13 CFR 121.201
- Excluded vehicles must include a label with the following statement: “THIS VEHICLE IS EXCLUDED UNDER 40 CFR 1037.150(c).\”

Useful Life

§1037.106(e)

- CO_2 standards are full useful life standards
  - For vehicles at or below 19,500 lbs GVWR:
    - 10 years/110,000 miles
  - For vehicles above 19,500 and at or below 33,000 lbs GVWR:
    - 10 years/185,000 miles
  - For vehicles above 33,000 lbs GVWR:
    - 10 years/435,000 miles
- Full useful life requirements also apply to air conditioning leakage program and credit programs

Rounding Requirements
§1065.20(e)

- Round values to the number of significant digits necessary to match the number of decimal places of the applicable standard

- GEM output in the “FEL” column correctly rounds to the appropriate significant digits
  - Grams CO_2/ton-mile are rounded to whole number
  - Fuel Consumption in gallons/1000 ton-mile are rounded to one decimal place

In-Use GHG Standards

§1037.105, §1037.150

- The FEL serves as the emission standard for the vehicle subfamily - §1037.105(d)

- We may measure the drag area of your vehicles after they have been placed into service. Your vehicle conforms to the regulations of this part with respect to aerodynamic performance if we measure its drag area to be at or below the maximum drag area allowed for the bin above the bin to which that configuration was certified (for example, Bin II if you certified the vehicle to Bin III), unless we determine that you knowingly produced the vehicle to have a higher drag area than is allowed for the bin to which it was certified - §1037.150(k)

Penalties & Non-compliance

- In-use Compliance
  - Where we find higher in-use FELs than the certified level, you must forfeit CO2 emission credits based on the difference between the in-use FEL and the otherwise applicable FEL. - §1037.645
    - Calculate the amount of credits to be forfeited using the applicable equation in §1037.705, by substituting the otherwise applicable FEL for the standard and the in-use FEL for the otherwise applicable FEL
- End-of-year CO_2 Credit Deficits - §1037.745
  - The certificate for a vehicle family for which you do not have sufficient CO_2 credits may be voided *ab initio* if you do not remedy the deficit within three model years. We will void the certificate only with respect to the number of vehicles needed to reach the amount of the net deficit.
- Penalties are discussed in preamble at 76 FR 57290, September 15, 2011
- Certification and enforcement provisions of §1037.750 also apply
  - Must meet in-use standards, keep records, send reports and information, etc.

Defeat Devices

- The CAA 203 (Title 42, Chapter 85, Subchapter II, Part A, Section 7522(a)(3)(B) includes a provision which prohibits defeat devices
  - "…for any person to manufacture or sell, or offer to sell, or install, any part or component intended for use with, or as part of, any motor vehicle or motor vehicle engine, where a principal effect of the part or component is to bypass, defeat, or render inoperative any device or element of design installed on or in a motor vehicle or motor vehicle engine in compliance with regulations under this subchapter, and where the person knows or should know that such part or component is being offered for sale or installed for such use or put to such use; …"
- Preamble reads as follows (76 FR 57267, September 15, 2011):
  - "Manufacturers are further required to attest that their AECDs are not "defeat-devices," which are intentionally targeted at reducing emission control effectiveness."

Running Change Requirements
§1037.225

- Must amend an application before:
  - Add a vehicle configuration to a vehicle family
  - Change a vehicle configuration already included in a vehicle family in a way that may affect emissions or change components described in the application
  - Modify a FEL for a vehicle family

- Send relevant information to the Designated Compliance Officer
  - If you are unclear if you need to file a running change, consult your certification representative

Warranty, Defect Reports & Recall

CAA section 207(a); 1037.15; 1037.120; 1037.601; 1068.501

- **Defect Warranty:**
  - Applies to emission-related parts, components, systems, software or elements of design which must function properly to assure continued compliance with GHG requirements.
  - Applies to emission-related components, systems, software or elements of design used to obtain credits for advanced technology vehicles, off-cycle technologies and early credits.
- **Defect Reporting & Voluntary Emission-Related Recall Reporting Requirements:**
  - Applies to emission-related parts, components, systems, software or elements of design which must function properly to assure continued compliance with GHG requirements.
  - Applies to emission-related components, systems, software or elements of design used to obtain credits for advanced technology vehicles, off-cycle technologies and early credits.
- **Recall:**
  - Applies to emission-related components, systems, software or elements of design which must function properly to assure compliance with GHG requirements.

Credits – ABT Example

Emission credits (Mg) = (Std-FEL) × (Payload tons) × (Volume) × (UL) × (10^{-6})

Where:

Std = the emission standard associated with the specific tractor regulatory subcategory (g/ton-mile).

FEL = the family emission limit for the vehicle subfamily (g/ton-mile).

Payload tons = the prescribed payload for each class in tons (12.5 tons for Class 7 and 19 tons for Class 8).

Volume = U.S.-directed production volume of the vehicle subfamily.

UL = useful life of the tractor (435,000 miles for Class 8 and 185,000 miles for Class 7).

An example:

The 2014MY Class 8 High Roof Sleeper Cab standard is 75 g/ton-mile. A manufacturer produces 1,000 vehicles in one subfamily within this subcategory with an average emissions of 74 g/ton-mile (rounded to whole number) during the 2014 model year. The manufacturer also produces 1,500 vehicles in a second subfamily within this subcategory with an average emissions of 73 g/ton-mile (rounded to whole number) during the 2014 model year. Lastly, the manufacturer produces 1,000 vehicles in one subfamily within this subcategory with an average emissions of 76 g/ton-mile (rounded to whole number) during the 2014 model year.

Subfamily #1 Emission credits = (75 – 74 g/ton-mile) × (19 tons) × (1,000 tractors) × (435,000 miles) × (10^{-6}) = 8,265.0 Mg of credits

Subfamily #2 Emission credits = (75 – 73 g/ton-mile) × (19 tons) × (1,500 tractors) × (435,000 miles) × (10^{-6}) = 24,795.0 Mg of credits

Subfamily #3 Emission credits = (75 – 76 g/ton-mile) × (19 tons) × (1,000 tractors) × (435,000 miles) × (10^{-6}) = -8,265.0 Mg of credits

Total Emission credits = 8,265 + 24,795 – 8,265 Mg = 24,795 Mg

Early Credits Example #1
Entire Subcategory

Emission credits (Mg) = (Std-FEL) × (Payload tons) × (Volume) × (UL) × (10^{-6}) × 1.5 multiplier

Where:

Std = the emission standard associated with the specific tractor regulatory subcategory (g/ton-mile).

FEL = the family emission limit for the vehicle subfamily (g/ton-mile).

Payload tons = the prescribed payload for each class in tons (12.5 tons for Class 7 and 19 tons for Class 8).

Volume = U.S.-directed production volume of the vehicle subfamily.

UL = useful life of the tractor (435,000 miles for Class 8 and 185,000 miles for Class 7).

An example:

The 2014MY Class 8 High Roof Sleeper Cab standard is 75 g/ton-mile, which is the standard for 2013MY. A manufacturer produces 1,000 vehicles in one subfamily within this subcategory with an average emissions of 74 g/ton-mile (rounded to whole number) during the 2014 model year. The manufacturer also produces 1,500 vehicles in a second subfamily within this subcategory with an average emissions of 73 g/ton-mile (rounded to whole number) during the 2014 model year.

Subfamily #1 Emission credits = (75 – 74 g/ton-mile) × (19 tons) × (1,000 tractors) × (435,000 miles) × (10^{-6}) × 1.5 = 12,397.5 Mg of credits

Subfamily #2 Emission credits = (75 – 73 g/ton-mile) × (19 tons) × (1,500 tractors) × (435,000 miles) × (10^{-6}) × 1.5 = 37,192.5 Mg of credits

Total Emission credits = 12,398 + 37,193 Mg = 45,590 Mg

Early Credits Example #2
SmartWay Designated Vehicles

Emission credits (Mg) = (Std-FEL) × (Payload tons) × (Volume) × (UL) × (10^{-6}) × 1.5 multiplier

Where:

Std = the emission standard associated with the specific tractor regulatory subcategory (g/ton-mile).

FEL = the family emission limit for the vehicle subfamily (g/ton-mile).

Payload tons = the prescribed payload for each class in tons (12.5 tons for Class 7 and 19 tons for Class 8).

Volume = U.S.-directed production volume of the vehicle subfamily.

UL = useful life of the tractor (435,000 miles for Class 8 and 185,000 miles for Class 7).

An example:

A manufacturer sells 250 2012MY Class 8 High Roof Sleeper Cabs with a SmartWay designation and sells 550 2013 MY Class 8 High Roof Sleeper Cab with a SmartWay designation. The 2014MY Class 8 High Roof Sleeper Cab standard is 75 g/ton-mile, which is the standard for 2013MY. The manufacturer selects 300 (=550-250) of the 2013MY tractors and runs them through GEM. Assuming that 150 of the vehicles in one subfamily have an emissions of 74 g/ton-mile (rounded to whole number) and the other 150 vehicles have an emissions of 73 g/ton-mile.

Subfamily #1 Emission credits = (75 – 74 g/ton-mile) × (19 tons) × (150 tractors) × (435,000 miles) × (10^{-6}) × 1.5 = 1,859.625 Mg of credits

Subfamily #2 Emission credits = (75 – 73 g/ton-mile) × (19 tons) × (150 tractors) × (435,000 miles) × (10^{-6}) × 1.5 = 3,719.25 Mg of credits

Total Emission credits = 1,860 + 3,719 Mg = 5,579 Mg

Advanced Technology Credit Example
1037.615

Emission credits (Mg) = (g/ton-mile benefit) × (Payload tons) × (Volume) × (UL) × (10^{-6}) × 1.5 multiplier

Where:

g/ton-mile benefit = Improvement Factor × GEM result from vehicle with technology

Where:

Improvement Factor = (Emission Rate without technology - Emission Rate with technology) / Emission Rate without technology

Payload tons = the prescribed payload for each class in tons (12.5 tons for Class 7 and 19 tons for Class 8)

Volume = U.S.-directed production volume of the vehicles with the innovative technology in the family

UL = useful life of the tractor (435,000 miles for Class 8 and 185,000 miles for Class 7)

An example:

A manufacturer produces 100 Class 8 high roof day cab tractors with a hybrid powertrain. During the chassis test, the conventional tractor emits 75 g/ton-mile, while the tractor with the hybrid emits 60 g/ton-mile. The GEM result from the vehicle with the hybrid is 74 g/ton-mile.

Improvement factor = (75 – 60) / 75 g/ton-mile = 0.20

Advanced Technology Emission credits = (0.20) × (74 g/ton-mile) × (19 tons) × (100 tractors) × (435,000 miles) × (10^{-6}) × 1.5 = 18,348 Mg of credits

Innovative Technology Credit Example

Emission credits (Mg) = (g/ton-mile benefit) × (Payload tons) × (Volume) × (UL) × (10^{-6})

Where:

g/ton-mile benefit = Improvement Factor × GEM result from vehicle with technology

Where:

Improvement Factor = (Emission Rate without technology - Emission Rate with technology) / Emission Rate without technology

Std = the emission standard associated with the specific tractor regulatory subcategory (g/ton-mile).

Payload tons = the prescribed payload for each class in tons (12.5 tons for Class 7 and 19 tons for Class 8).

Volume = U.S.-directed production volume of the vehicles with the innovative technology in the family.

UL = useful life of the tractor (435,000 miles for Class 8 and 185,000 miles for Class 7).

An example:

The 2014MY Class 8 High Roof Sleeper Cab standard is 75 g/ton-mile. A manufacturer produces 100 vehicles in one subfamily within this subcategory with an innovative technology which demonstrates an improvement factor of 0.10 during the 2014 model year. The GEM result for this subfamily is 74 g/ton-mile.

Innovative Technology Emission credits = (0.10) × (74 g/ton-mile) × (19 tons) × (100 tractors) × (435,000 miles) × (10^{-6}) = 6,116 Mg of credits