



Small SI Engines: Compliance and Emerging Issues

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What is “Small SI” ?

- Nonroad Small Spark-Ignited (SI) engines
 - Power ratings ≤ 19 kW
 - Allowance for engines ≤ 30 kW and ≤ 1000 cc
 - Primarily used in lawn & garden applications
- Handheld
 - Carried by operator during operation
 - Operates multi-positionally
 - Class III (<20 cc displacement engine)
 - Class IV (displacement ≥ 20 cc and <50 cc)
 - Class V (displacement ≥ 50 cc)
- Nonhandheld
 - Class I (>80 cc and <225 cc)
 - Class II (≥ 225 cc)



What is the Environmental Impact of Small SI ?

	2002	2030 (w/o Phase 3)
VOC	14%	23%
NO _x	1%	3%
CO	20%	27%
PM _{2.5}	5%	11%

Source: EPA's Phase 3 Final Rule, October 2008



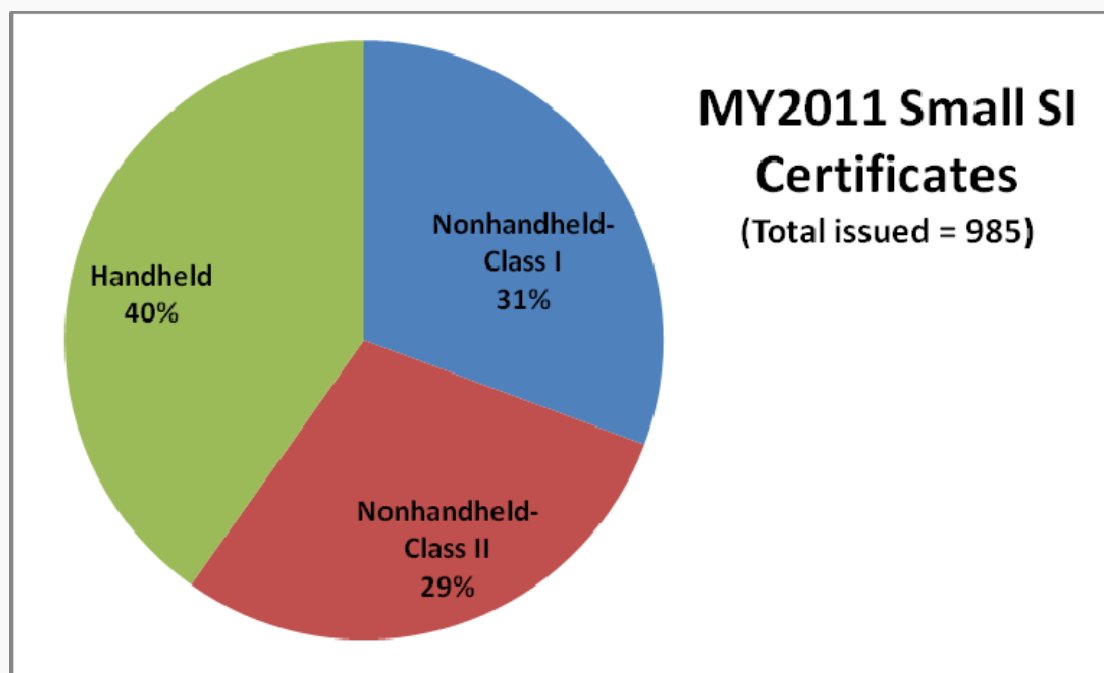
What are the EPA Regulations for Small SI ?

- Phase 1 regulations
 - Exhaust only
 - Implemented with Model Year (MY)1997
- Phase 2 regulations
 - Exhaust only
 - Phased in between MY 2001 and MY 2007
- Phase 3 regulations
 - Exhaust and Evaporative requirements
 - Began in calendar year 2009
 - Fully implemented in MY 2012
- Additional leadtime generally provided for small-volume engine manufacturers



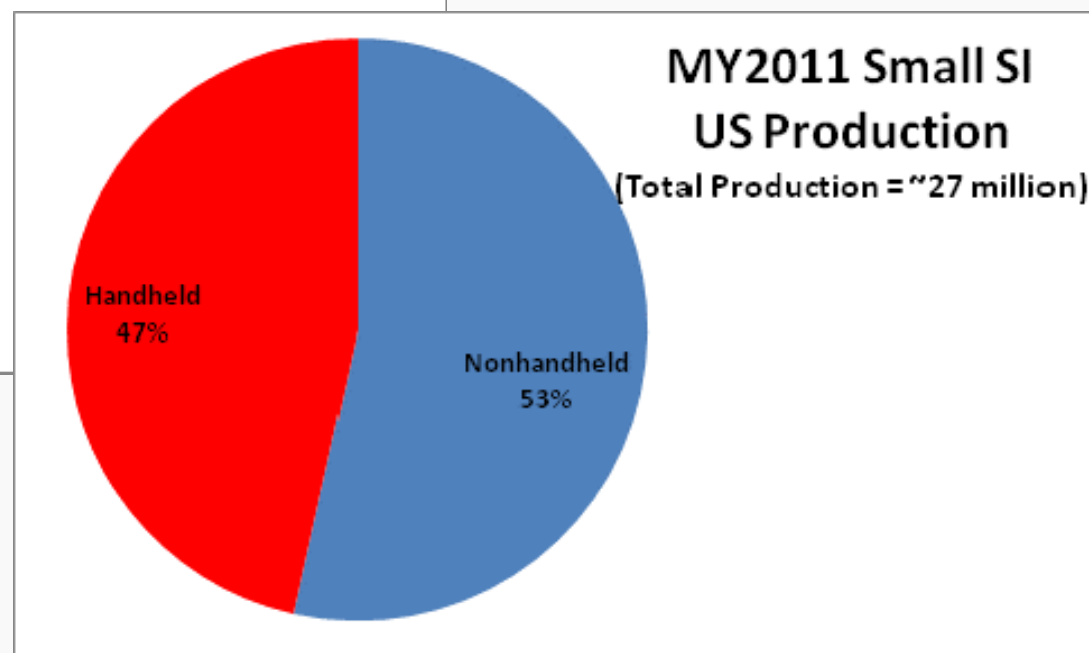
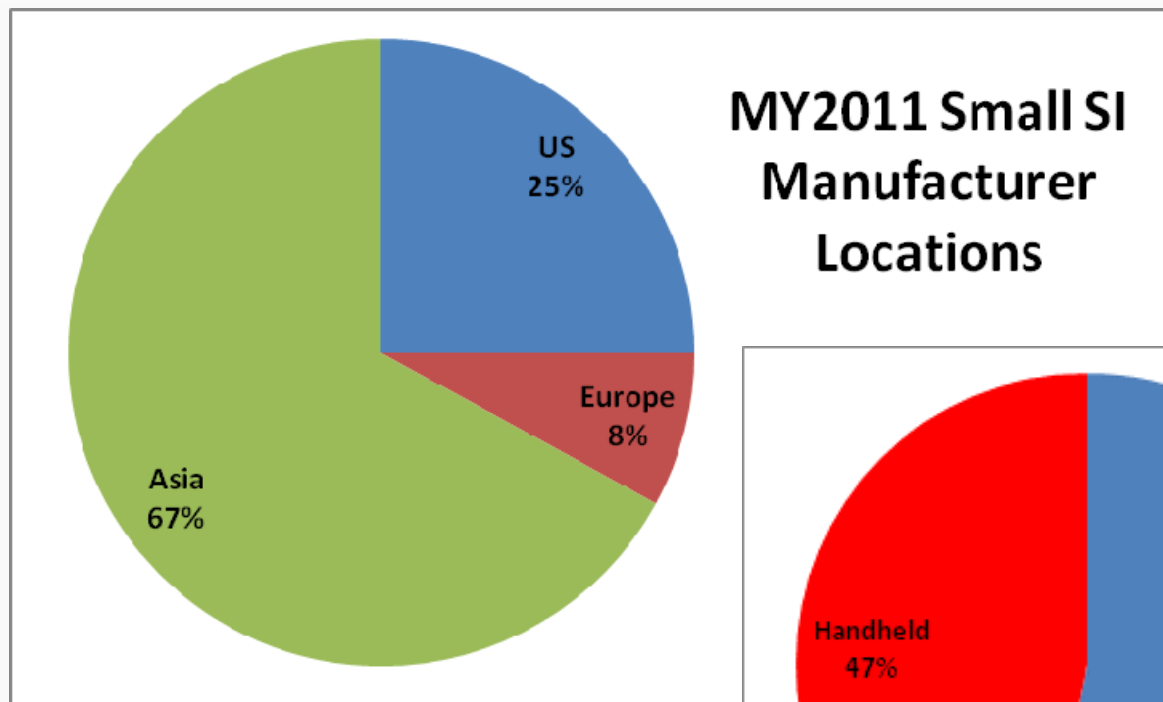
Small SI Industry

Model Year	Number of Manufacturers	Number of Engine Families
1998	43	432
2005	99	713
2011	105	985





Small SI Industry





What are the Phase 3 Exhaust Standards ?

Engine Class	HC+NO _x (g/kW-hr)	CO (g/kW-hr)	Effective Date
Class I	10.0	610	2012 MY
Class II	8.0	610	2011 MY
Class III	50	805	2010 MY
Class IV	50	805	2010 MY
Class V	72	603	2010 MY



What are the Evaporative Requirements ?

- First evaporative standards for all Small SI
 - New Standards begin in 2009 calendar year
 - Fully implemented in 2012 MY
- Regulated Items:
 - Fuel Line Permeation
 - 15 g/m²/day standard for non-cold-weather fuel lines
 - Fuel Tank Permeation
 - 1.5 g/m²/day standard at 28°C, 2.5 g/m²/day standard at 40°C
 - Running Loss (Small SI nonhandheld only)
 - Route fuel tank vapors to intake during engine operation
 - Seal fuel tank during normal operation
 - Obtain CARB approval



What are the steps in Obtaining Certification?

- Pre-Certification
- Certification/Compliance
- Post-Certification



Pre-Certification

- Manufacturer oversight of consultant/lab
 - Certifying entity is responsible for engine/equipment compliance
 - Emissions data
 - Typical lab contract will store data for 2-3 years (regulations require 8 years)
 - Appropriate test procedure run
 - Warranty
- Agent for Service (§1054.205(z))
 - Person or legal entity located in U.S. who represents your company
 - Name, phone number, and email address must be accurate at all times
- US-based emissions test facility (§1054.205(aa)(3))
 - Lab must have capability to test your Small SI engine families
 - Selective Enforcement Audits (SEA) run in the United States



Pre-Certification (cont.)

- Repair network (§1054.120(f))
 - Toll free phone number, email address, and warranty claim method (e.g., free shipping) must be accurate at all times
- Approval requests
 - Alternate procedures, DF carry-across, exemptions, etc.
 - Contact your certification representative or send email to: Nonroad-SI-cert@epa.gov



Certification/Compliance

- Manufacturers should ensure engines match emissions configuration in engine family application
 - Adjustable parameters (§1054.205(q) and guidance CD-12-11)
 - Send pictures with application
 - Send CARB approval with application, if applicable (file of computer screen shot of approval is acceptable)
 - Catalyst information (§1054.205(a))
 - Application must include accurate information regarding catalyst part number, location, substrate material, and precious metal loading and ratio
 - Ensure catalyst is listed as an emission control strategy on engine label
 - Secondary air, or pulse air (§1054.205(a))
 - Application must include part number
 - Ensure pulse air is listed as an emission control strategy on engine label
 - Labels (§1054.135)
 - Send file showing sample label with application
 - Include description and code for engine date of manufacture if this information is not included on the label



Certification/Compliance (cont.)

- Small SI Bond Policy (§1054.690)
 - All Small SI manufacturers required to post bond before engines enter into U.S. commerce (unless have sufficient US assets)
 - Compliance Division asks manufacturers for copies of bond policies throughout the calendar year
- Certification Test Fuel for emissions work
 - Gasoline as specified in §1065.710
 - CARB Phase 2 test fuel acceptable through 2012 model year (§1054.145(k))
 - Some manufacturers have requested an Alternate Procedure (§1065.12) to use CARB Phase 2 fuel for 2013 with emission data
 - EPA has already approved some requests
 - EPA is considering issuing a Guidance Document allowing CARB Phase 2 test fuel for the 2013 model year for any manufacturer



Certification/Compliance (cont.)

- Confirmatory Tests (§1054.235(c))
 - EPA issues test orders to emissions certification representative and Agent for Service for specific engine families
 - Test orders are issued prior to certification approval
 - EPA testing began in 2008
 - Almost 100 families have been selected between 2008 and 2012
 - 25% of requested engine families failed or left the US market in 2011
 - Certificate is not issued if engine family fails the confirmatory test
- Selective Enforcement Audits (SEA) - (40 CFR 1068, Subpart E)
 - Recent testing began in 2010 and is expanding
 - Manufacturers must test production engines
 - EPA may be present for engine selection and testing
 - Emission tests run at US-based facility listed in certification application
 - Number of engines passing/failing determines if a family passes or not
 - Engine certificate is suspended if family fails the SEA



Certification/Compliance (cont.)

- Equipment Certification is a new requirement under the Phase 3 regulations (§1060.5)
- NHH equipment is required to be certified
 - Must use EPA-certified fuel tank and fuel line, plus control running losses
 - Engine manufacturers may certify the “equipment” if engine is sold with complete fuel system
 - Otherwise, equipment manufacturer must certify
- HH and Wintertime equipment certification is optional (§1060.104(a))
 - Must use EPA-certified fuel tank and fuel line
 - May use a vented fuel cap
 - Not required to meet running loss requirements



Certification/Compliance (cont.)

- **January 2013 Verify shutdown**
 - Verify will be shutdown from January 3rd thru 14th, 2013
 - **No access for manufacturers or EPA!!!!!!!!!!**
- EPA strongly encourages users to plan ahead
 - See Guidance Letter CD-12-14 for more information.



Post-Certification

- Additional requirements after engine certificate is issued
 - Production Line Testing (PLT)
 - Averaging, Banking, and Trading (ABT), if applicable
 - Annual Production Reports
 - Defect Reports
- EPA developed templates for manufacturers to submit ABT, PLT, and Production reports
 - Templates can be found at <http://www.epa.gov/otaq/certdat2.htm>
 - Currently ABT, PLT, and Production reports must be sent to abt_engine@epa.gov, plt@epa.gov, and prod_data@epa.gov
 - EPA will issue a guidance document when the Verify system can accept these reports



Post-Certification (cont.)

- Production Line Testing (PLT) – (§1054, Subpart D)
 - Manufacturers perform low-hour emission tests on production engines
 - Maximum number of engines tested is 30 or 1% of production, whichever is lower
 - PLT does not apply to Small-volume manufacturers
 - Manufacturers must request EPA approval to be exempt from PLT requirements for a small-volume emission family
 - Statistical analysis determines if the engine family passes/fails
 - Manufacturers must notify EPA if an engine family fails its PLT
 - An PLT engine that fails its low-hour emission test cannot enter into U.S. commerce
 - Engine certificate is suspended if family fails
 - Reports must be submitted to EPA
 - As often as quarterly (within 45 days after end of quarter)
 - Approximately 650 engine families were subject to PLT testing out of the 985 engine families in MY2011



Post-Certification (cont.)

- Averaging Banking and Trading (ABT) – (§1054, Subpart H)
 - ABT allows manufacturers to certify engines above or below the standards and demonstrate they meet the standards on average¹
 - ABT applies for HC+NO_x standards only
 - Separate programs for Handheld and Nonhandheld Engines
 - Manufacturers must declare a Family Emission Limit (FEL) in their certification application(s)
 - Exhaust emissions must meet the FEL, rather than the standard
 - Manufacturers participating in the ABT program must submit two reports to EPA with credit calculations/balances
 - End-of-Year report due 90 days after end of model year
 - Final report due 270 days after end of model year
 - 19 engine manufacturers participated in the ABT program for MY2011

¹. Note: FEL Caps apply.



Post-Certification (cont.)

- Annual Production Report (§1054.250)
 - New requirement with Phase 3 regulations
 - Manufacturers submit their U.S.-directed production for each engine family
 - Report due 45 days after end of model year
 - Total U.S.-directed production for 2011
 - Handheld engines: ~14.3 million units
 - Nonhandheld engine: ~12.4 million units



Post-Certification (cont.)

- Defect reporting (§1068.501)
 - Applies to emission-related components/systems for both engines and evaporative components
 - Manufacturers must report defects when they reach a specified threshold
 - Threshold varies by production level (generally 2%)
 - Report within 21 days of determining you met the threshold
- Defect report must include a variety of information
 - Defect description, number of engines affected, estimate of emission impact, plan for addressing defect or reasons why effect does not need to be addressed
 - Include copy of dealer notification, technical bulletin, etc.
 - Submit to your EPA certification representative



Emerging Issues

- Certification test fuels
- Off-road utility vehicles (UTVs)
- Future emission requirements



Fuels

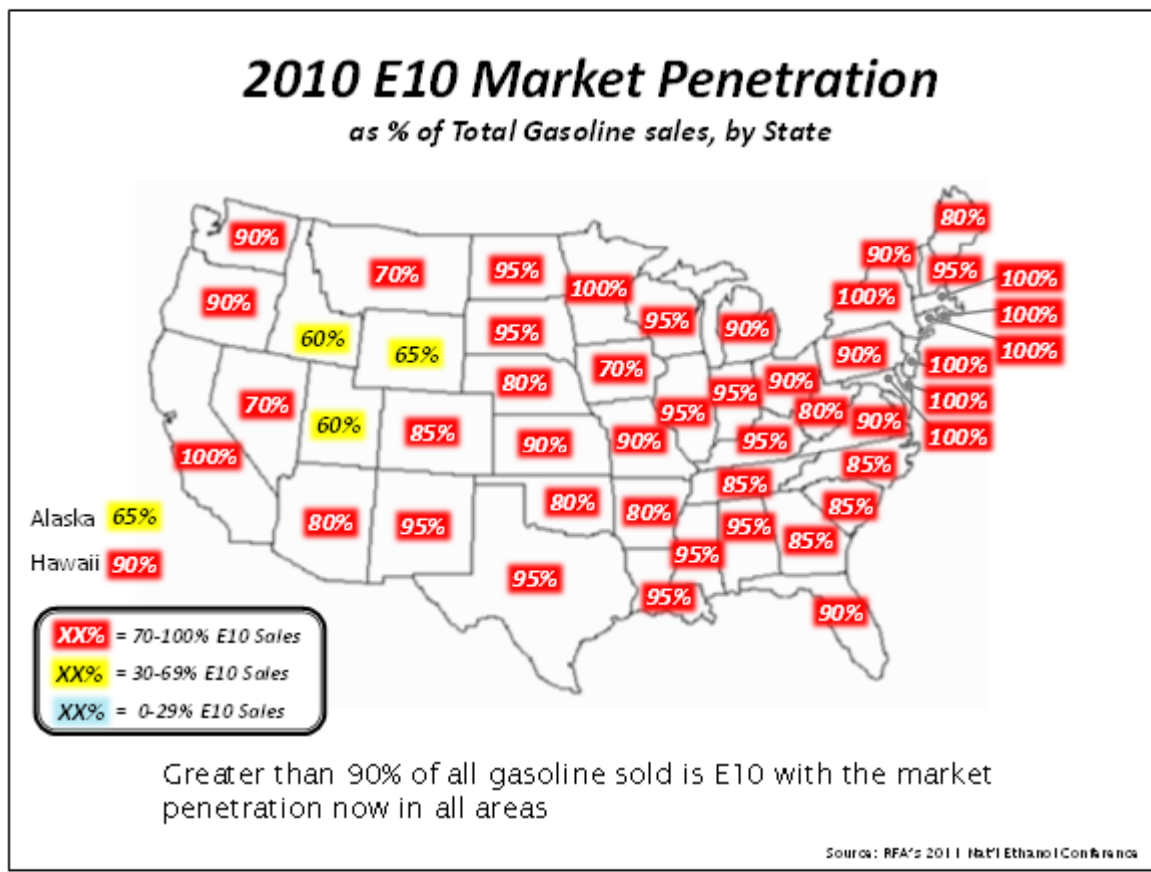
- Equipment engines and fuels operate together as a system: thus, fuel qualities such as sulfur content, vapor pressure, and ethanol content are significant in the design and operation
- These properties vary throughout the US and throughout the world
- Important to understand current situation and future trends, especially since nonroad power equipment is a very small fraction of demand
- Important precept is to align properties of emission certification test fuel and in-use fuel



Trends

- Sulfur: 10 ppm California; 30 ppm rest of US
- Increased use of ethanol
 - Renewable Fuel Standard
- Pushes for lower sulfur and RVP
 - Influenced by automotive and fuel refining interests

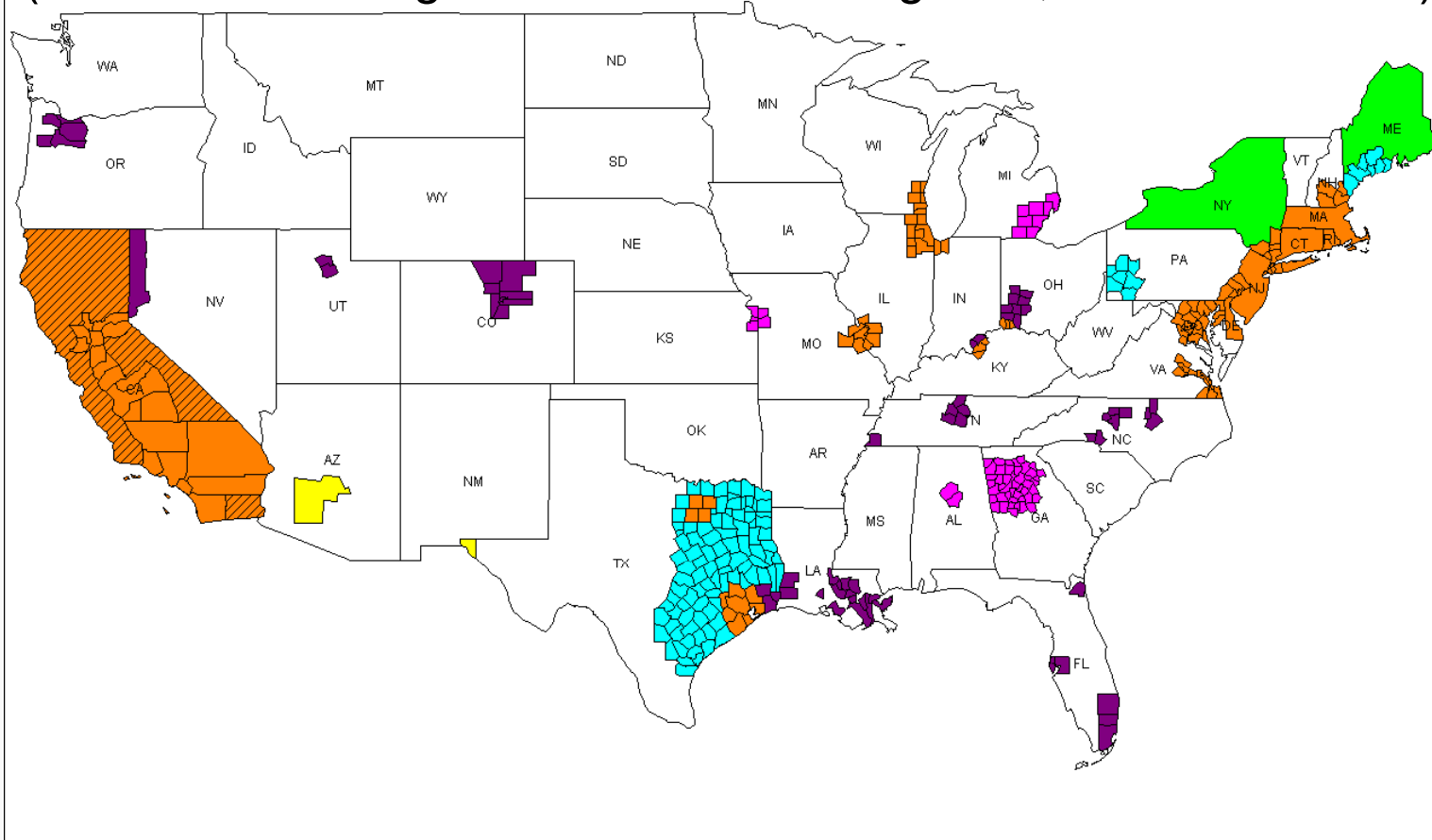
Ethanol in Retail Gasoline





Current In-Use RVP Levels

(Based on Existing State & Federal Programs, E10 Nationwide)



■CaRFG3 ■EPA RFG ■RVP 7.0 ■RVP 7.8 ■RVP 8.0 ■RVP 8.8 ■RVP 9.0 □RVP 10.0



Near Term Issue

- EPA and California ARB try to harmonize emission requirements so that there can be 50-state products
 - Central to this effort is common agreement on emission test procedures and certification test fuels
 - ARB has recently adopted CA RFG 3 (7 RVP E10) and has a requirement that by 2020 exhaust and evaporative emission certifications use this test fuel
 - This replaces CA RFG 2 which was 7 RVP but used 11% MTBE
 - Between 2013 and 2019 can use Federal certification fuel, CA RFG 2 or CA RFG 3 for California
- Working now to find a way to facilitate smooth transition
 - Federal rules written in 2008 eliminated CA RFG 2 option after 2012 and do not yet recognize CA RFG 3
 - For 2013, emission test data from Federal certification test fuel will be accepted by EPA and ARB
- Potential for change in Federal certification test fuel properties



Off-road Utility Vehicle (UTVs) Emissions Certification

**IS THE VEHICLE AN ATV OR A
UTV?**



All Terrain Vehicle 40 CFR 1051.801

- Vehicles designed to travel on four low pressure tires having a seat designed to be straddled by the operator and handlebars for steering controls and intended for use by a single operator with no passengers
- Vehicles with three or more wheels and one or more seats designed for operation over rough terrain, are intended primarily for transportation, and have a maximum vehicle speed greater than 25 mph.
- ATVs are deemed to be primarily intended for recreational use

ATVs and UTVs

ATV



UTV





Off-road UTV 40 CFR 1051.801

- Regulatory Definition:
 - Nonroad vehicle
 - 4 or more wheels
 - Seating for 2 or more passengers
 - Designed for operation over rough terrain
 - Rear payload capacity \geq 350 lbs or capable of transporting 6 or more passengers
 - Not primarily intended for recreational use
- Is recreational use:
 - If marketed as such, or
 - Has a rear payload capacity
- < 1000 lbs and meets 5 of 7 of these criteria
 1. Front/rear suspension travel is > 18cm
 2. The vehicle has no tilt bed
 3. Vehicle has no PTO and no permanently installed system for operating accessory devices
 4. Engine has no in-use operating speeds > 4000 rpm
 5. Max vehicle speed greater than 35 mph
 6. Speed at which engine produces peak power is > 4500 rpm
 7. GVWR \leq 3750 lbs

If a vehicle is primarily intended for recreational use EPA defines it as is an ATV for emissions purposes



If you are a UTV what standards apply?

Use Small nonroad spark ignition – 40 CFR 1054

- Max engine power \leq 19 kW or
- >19 but <30 kW and engine displacement less than 1 liter ... other wise large SI
- Max vehicle speed \leq 25 mph
- Exhaust and evaporative emission requirements
- Applies to engine manufacturer

Use ATV certification requirements - 40 CFR 1051

- Engine displacement less than 1 liter
- Max engine power \leq 30 kW
- Max vehicle speed $>$ 25 mph
- Exhaust and evaporative emission requirements
- Currently there are options for engine and chassis emission certification

* If max engine power is >30 kW or displacement $>$ 1 liter, then Large SI standards apply
* Diesel engines for UTVs can be certified as an engine to diesel standards or as an ATV



Integrated and Non-Integrated Chassis UTV Manufacturers

- An integrated manufacturer is one which holds the emission certificates and manufactures the chassis
- Non-integrated is when one manufacturer holds the engine emissions certificate and another manufactures the chassis and may do the evaporative certification
- Under current UTV regulations a non-integrated approach can be used whether the UTV certifies as small SI or to the ATV requirements
 - Separate engine and evaporative certification are allowed
- These regulatory provisions will change for 2014 and later



Chassis Certification Requirement

- The option to certify ATV engines separately phases out over 2013-2014
- Likewise, the provision which allows for a separate engine certification for UTVs required to meet ATV requirements (e.g., > 25 mph) phases out over 2013-2014 ... mandatory chassis certification
- A potentially significant change for two reasons
 1. Trend toward higher speeds in future UTV offerings puts more UTVs over 25 mph
 2. Non-integrated UTV manufacturers which relied on separate engine emissions certification in the past now have to integrate the engine into the drive train before emissions evaluation
 - Likely to have a g/kw-hr engine emission rate but must integrate into the UTV chassis to understand g/km chassis test emissions performance
 - May have challenges in getting engine modifications to reduce emissions



Observations on Chassis Certification Requirement

- Most UTV manufacturers have used separate engine certification in the past and now have to develop chassis emission measurement and certification capabilities
 - The chassis certification requirement for 2014 and later has been in place since 2007
 - Several UTV manufacturers have the capability today and meet the new test procedure requirement and applicable emission standard
 - The use of small catalysts is common on these UTVs
- Complicated because California still has separate engine certification option for 2013 and later ... accepts chassis certification as well



Manufacturer Issue

- At least one manufacturer has expressed concern that chassis certification requirement could limit product offerings for over 25mph UTVs
 - Time to integrate loose engine into drive train and chassis before emissions assessment and time to assess variants
 - Concern over limited ability to get UTV application specific engine modifications to reduce emissions



EPA Thoughts

- Issue raised very recently
- Now assessing current certification approaches from UTV manufacturers (engine or chassis), emissions performance, and plans or problems going forward
 - Individual company outreach as needed including major OEMs and imports
- Identify and evaluate responses and options
- While we have some time to work with, suggest that manufacturers proceed with efforts to comply with rule as written



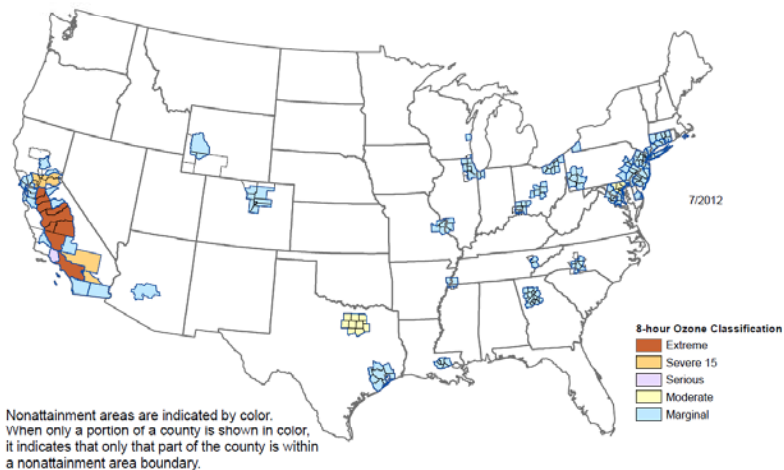
FUTURE EMISSION REQUIREMENTS



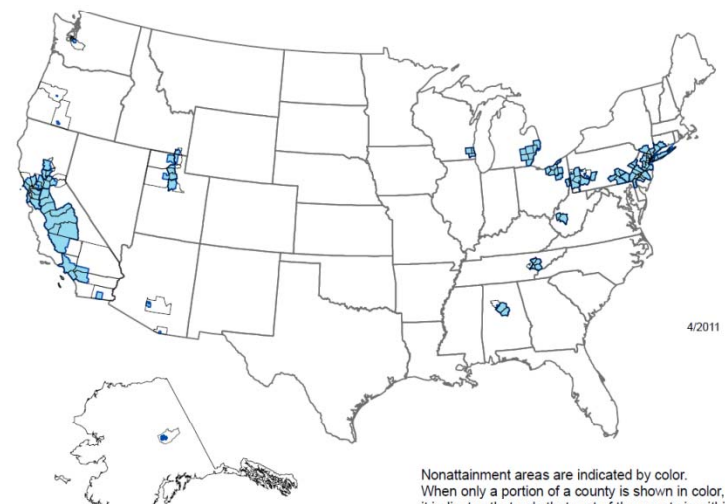
Air Quality

- EPA rules are designed to meet public health and welfare needs
- Still significant ozone and PM NAAQS attainment concerns in many areas

8-Hour Ozone Nonattainment Areas (2008 Standard)



PM-2.5 Nonattainment Areas (2006 Standard)





Potential Future Requirements

- While there are still some areas where improvement in emissions performance is possible, EPA has no near term plans for a new rulemaking action
 - Previous rules just completing phase-in now
 - Work with manufacturers on program tweaks as needed
- Will work with California ARB if they move toward future requirements