

## Public Workshop to Discuss Proposed Changes to the Small Off-Road Engine Regulations

Sacramento  
November 2, 2015

Diamond Bar  
November 4, 2015





# Presentation Outline

## **Background and Regulatory History**

Implementation of 2003 Evaporative Regulation

Proposed 2016 Regulatory Amendments

Need for Additional Emissions Reductions

Development of 2018 Regulatory Proposal

Next Steps

# What Are Small Off-Road Engines?

Lawn and garden equipment



Other utility equipment and specialty vehicles



Federally regulated equipment



(> 45 cc)



# Sources of Emissions



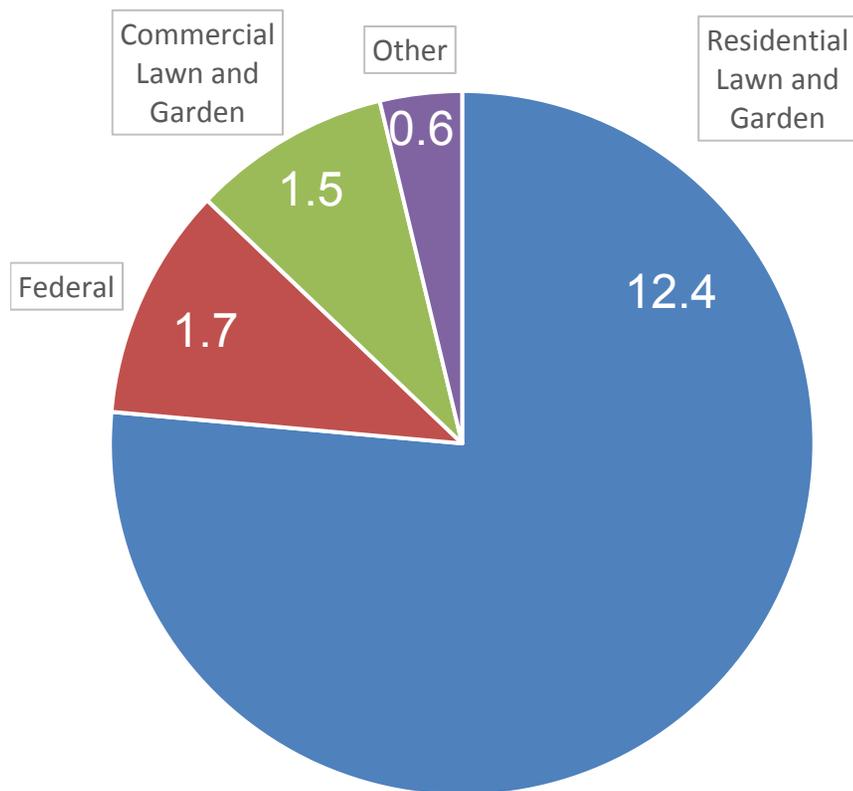
Exhaust and evaporative  
running loss  
(Operating)



Evaporative  
(After operation and  
during storage)

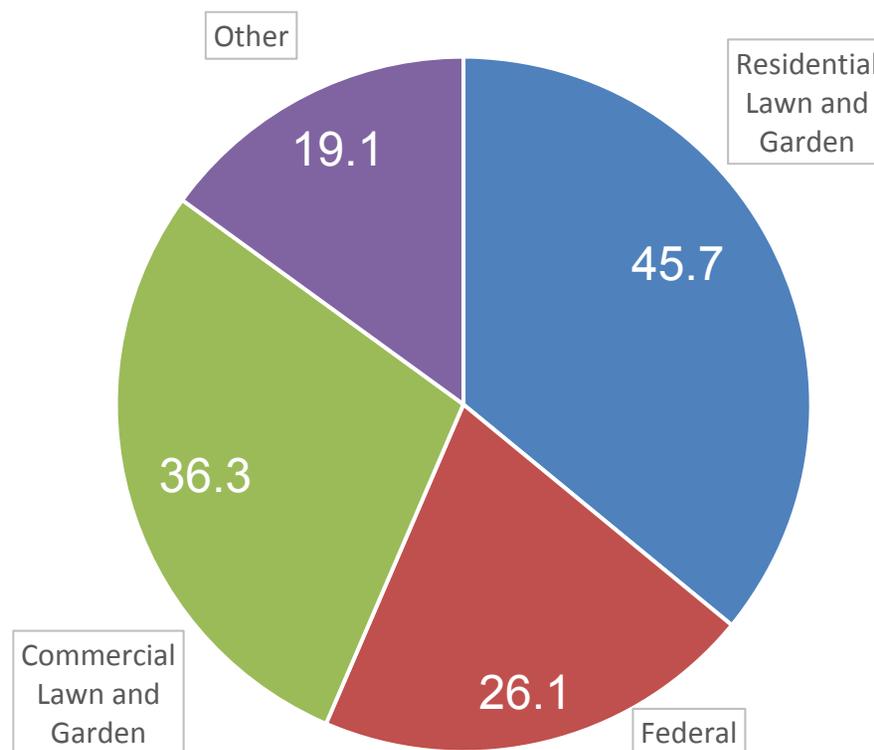
# Statewide 2015 SORE Population and Emissions

Population (millions)



16.2 million total

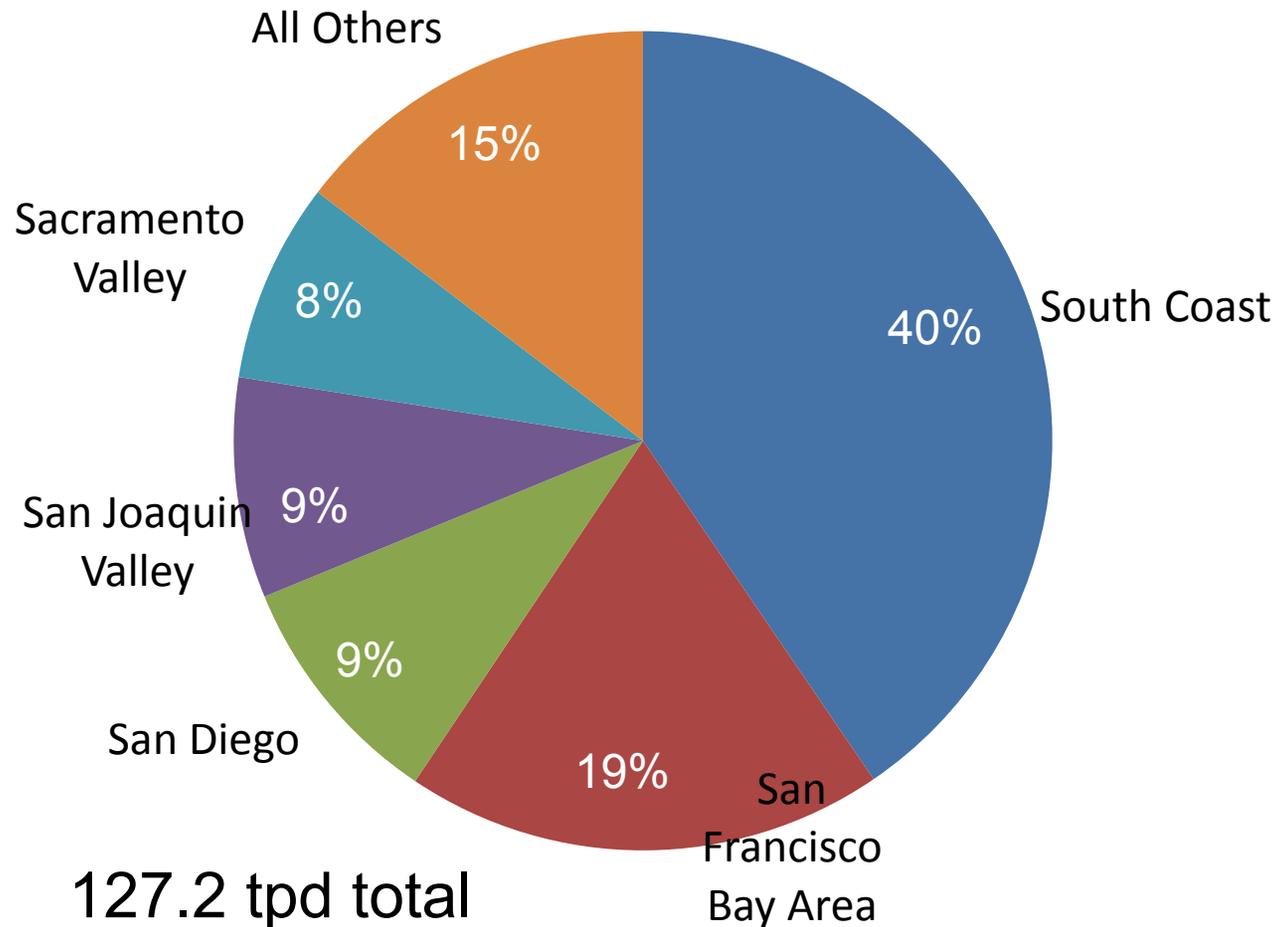
HC + NO<sub>x</sub> Emissions (Exhaust + Evap, tons per day, tpd)



127.2 tpd total

# 2015 SORE Emissions by Air Basin

HC + NOx Emissions (tpd)



# South Coast Air Basin Emissions

2015	
Source Category	tpd <sup>a</sup>
Heavy Duty Vehicles	190
Light Duty Vehicles	187
SORE	51
Recreational Boats	49
Ocean Going Vessels	33
Construction and Mining Equipment	28
Trains	25
Aircraft	17
Commercial Harbor Craft	13
Commercial Equipment	11
Fuel Storage and Handling	10
Industrial Equipment	9
Other Off-road Equipment	8
Transport Refrigeration Units	6
Farm Equipment	4
Port and Rail Operations	3
Airport Ground Support Equipment	3
Oil Drilling and Workover Equipment	1
<b>Mobile Sources Total</b>	<b>647</b>
<b>All Sources Total</b>	<b>944</b>

2023	
Source Category	tpd <sup>a</sup>
Heavy Duty Vehicles	86
Light Duty Vehicles	89
SORE	46
Recreational Boats	34
Ocean Going Vessels	25
Construction and Mining Equipment	16
Trains	24
Aircraft	20
Commercial Harbor Craft	11
Commercial Equipment	7
Fuel Storage and Handling	7
Industrial Equipment	7
Other Off-road Equipment	8
Transport Refrigeration Units	5
Farm Equipment	2
Port and Rail Operations	2
Airport Ground Support Equipment	1
Oil Drilling and Workover Equipment	1
<b>Mobile Sources Total</b>	<b>392</b>
<b>All Sources Total</b>	<b>704</b>

2031	
Source Category	tpd <sup>a</sup>
Heavy Duty Vehicles	65
Light Duty Vehicles	64
SORE	49
Recreational Boats	24
Ocean Going Vessels	23
Construction and Mining Equipment	10
Trains	21
Aircraft	23
Commercial Harbor Craft	10
Commercial Equipment	5
Fuel Storage and Handling	4
Industrial Equipment	6
Other Off-road Equipment	8
Transport Refrigeration Units	5
Farm Equipment	2
Port and Rail Operations	2
Airport Ground Support Equipment	1
Oil Drilling and Workover Equipment	1
<b>Mobile Sources Total</b>	<b>322</b>
<b>All Sources Total</b>	<b>652</b>

<sup>a</sup> ROG + NO<sub>x</sub>, mobile sources

$$\frac{LDV}{SORE} = \frac{187}{51} = 3.7$$

$$\frac{LDV}{SORE} = \frac{89}{46} = 1.9$$

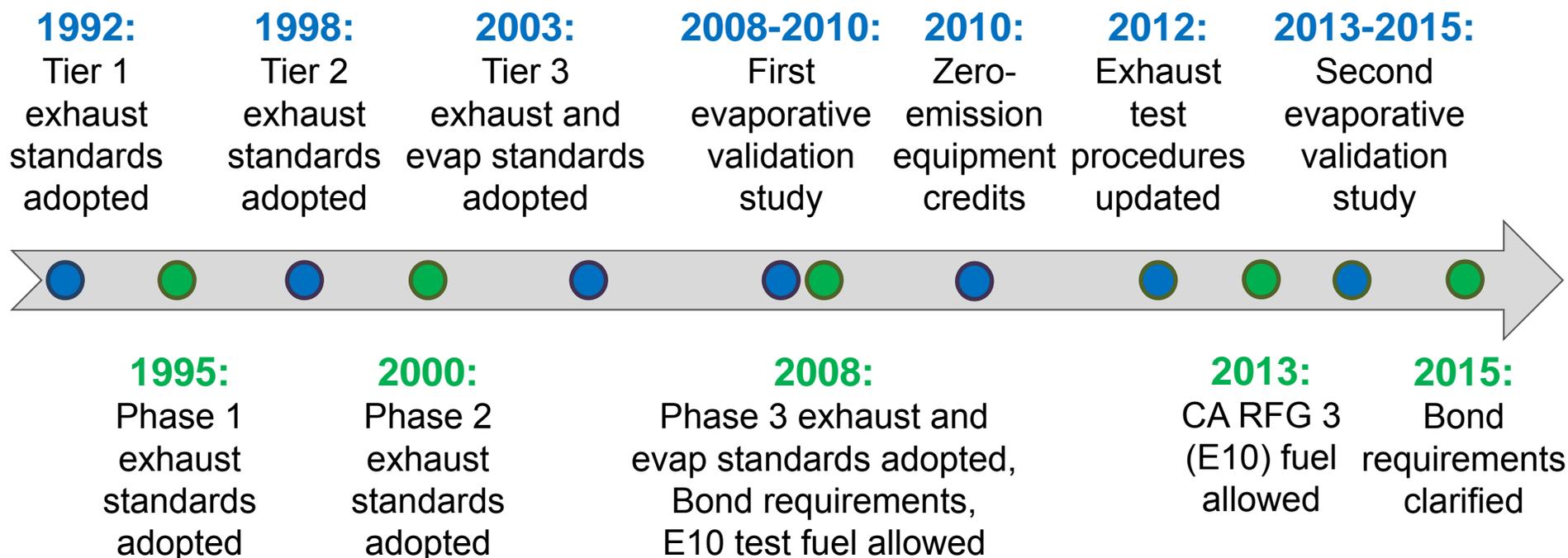
$$\frac{LDV}{SORE} = \frac{64}{49} = 1.3$$

# 2015 Population and Emissions Summary

- Residential lawn and garden equipment
  - 76% of population
  - 36% of total HC + NO<sub>x</sub> emissions
- Commercial lawn and garden equipment and federally preempt sources
  - 20% of population
  - 50% of total HC + NO<sub>x</sub> emissions
- SORE emissions more significant in future years
- SORE emissions are 8% of mobile source HC + NO<sub>x</sub> in the South Coast in 2015, but 15% by 2031

# SORE Regulatory History

## ARB



## U.S. EPA

# SORE Emissions Standards

HC + NO <sub>x</sub> (g/kW-hr)					
Standards Tier	Year	< 50 cc	50 - 80 cc	81 - 224 cc	≥ 225 cc
Tier 1	1995	274 <sup>a</sup>	166	16.1	13.4
Tier 2	2000	72	72		
	2002				12.0
Tier 3	2005	50			
	2007			10.0	
	2008				8.0

<sup>a</sup> average of standards for < 20 cc and 20-49 cc



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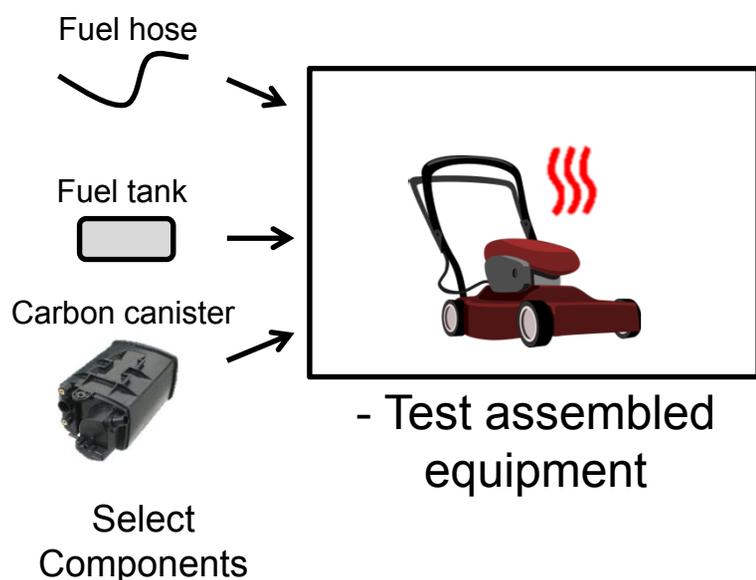
Development of 2018 Regulatory Proposal

Next Steps

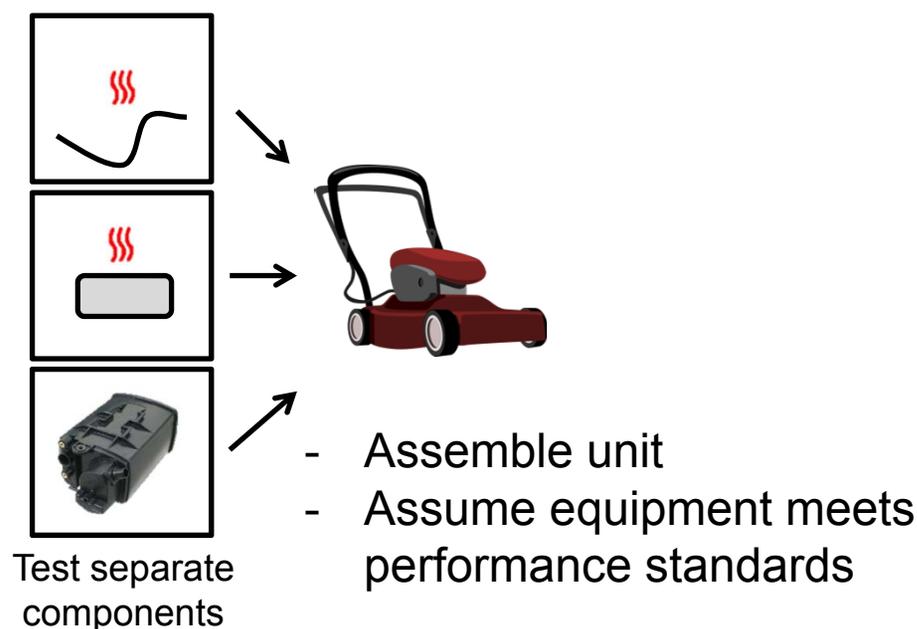
# 2003 Regulation Amendments

- Tightened exhaust standards
- Established first standards for evaporative emissions
- First ARB regulation to provide design-based certification pathway

## Performance-based



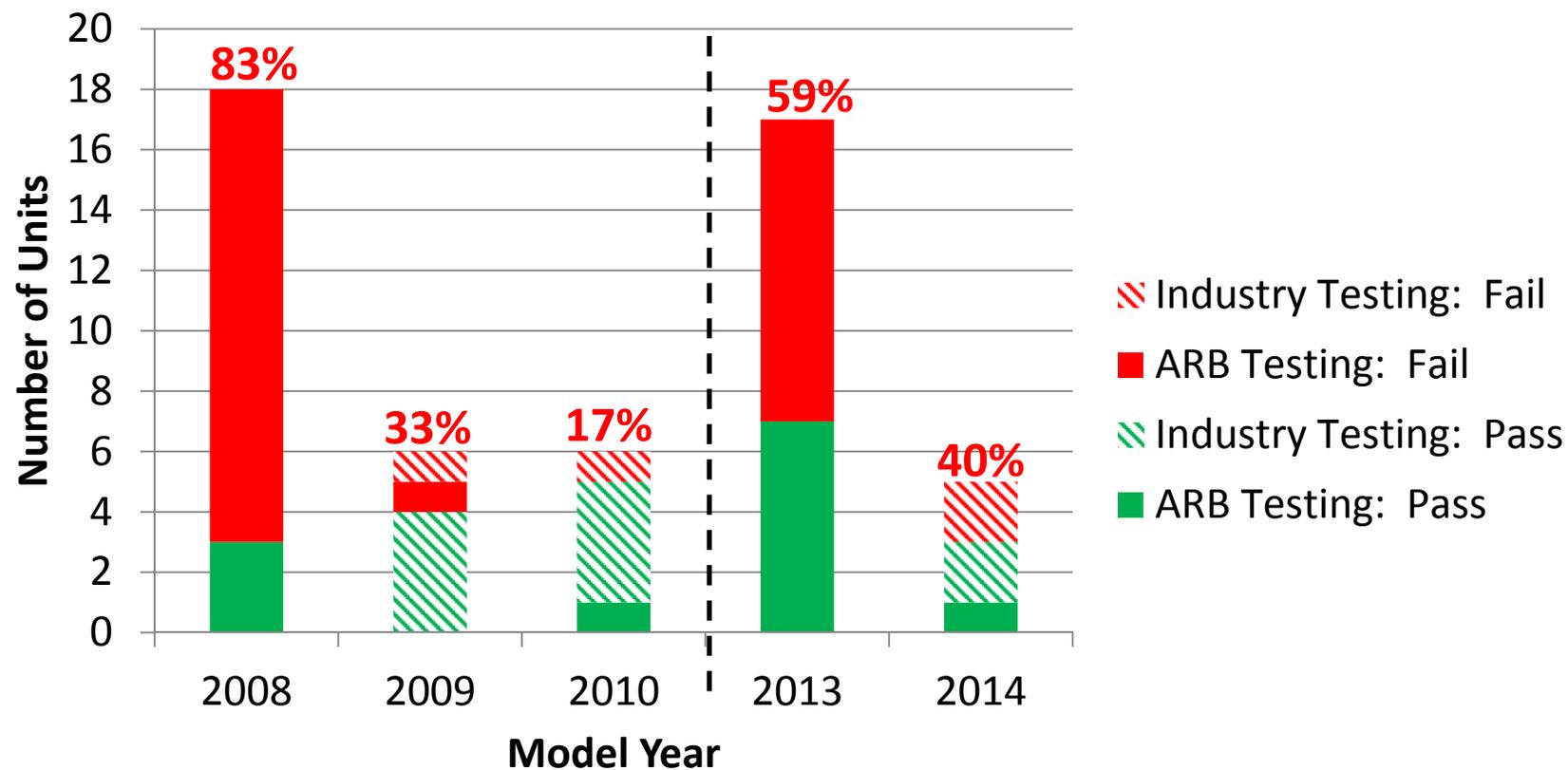
## Design-based



# Evaporative Emissions Validation Studies

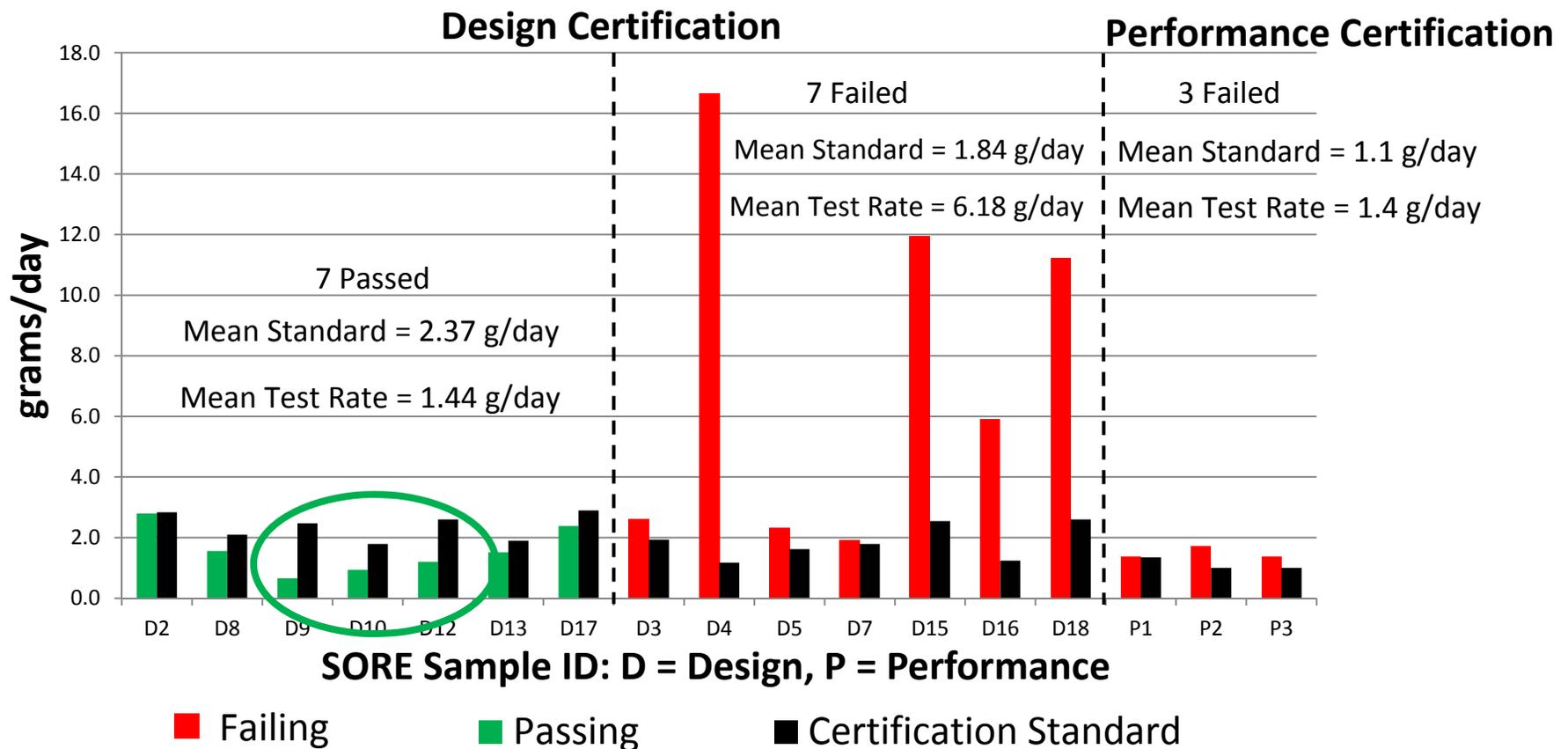
- Required by 13 CCR 2754.2
  - Model years 2008-2010 and 2013-2015
  - 15 design-based and 3 performance-based units in 2008 and 2013
  - 5 design-based and 1 performance-based in other model years
- Three, 24-hour diurnal tests per unit
- Executive Officer determines whether certification options are meeting ARB's emission reduction goals

# SORE Validation Study Results



# SORE MY 2013 Evaporative Emission Validation Study Results

(Maximum Result of 3 Tests)



# SORE Validation Study Observations

- Results differ significantly by manufacturer
- ARB failure rate is greater than industry failure rate
- Failure rate isn't improving enough with time
- Formation of government/industry SORE working group
- Need for modifications to certification process and streamlining SORE compliance testing process



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# 2016 SORE Rulemaking Proposal Overview

- Board Hearing November 2016
- Evaporative emissions certification fuel change
- Harmonization with U.S. EPA regulations
- Changes to certification and test procedures
  - Facilitating compliance testing and enforcement
  - Limited term certification for evaporative components
  - Clarification of certification requirements



# Evaporative Emissions Certification Fuel Change

- Current ARB certification fuel contains no ethanol (E0)
- E10 fuel required for MY 2020 for exhaust certification
- Require E10 fuel for evap certification for MY 2020
  - Provides three year lead time
  - Consistent with exhaust requirement
  - Consistent with Phase III reformulated gasoline

# Harmonization with U.S. EPA Regulations

- Low-permeation fuel tank design requirements
  - Minimum barrier thickness (EVOH)
  - Low-permeation gaskets and fuel caps
- Eliminate small production-volume tank exemption
- Eliminate exemption from standards and testing for low-permeation tanks on engines  $\leq 80$  cc
- Require all testing data to be submitted to ARB

# Increasing Compliance

- Align compliance and certification test requirements
  - Accounts for engine production variability
  - Manufacturers of failing equipment subject to remedies
- Enable ARB to purchase engines or components for testing
  - Alternative to obtaining from manufacturers
  - Simplifies the process
- Explore bonding requirements for manufacturers
  - Similar to U.S. EPA's requirements
  - Provides accountability for manufacturers not based in USA

# Evaporative Emissions Compliance Requirements

- Design standards will remain a separate certification option
- Certification to design standards will remain a convenience
- All equipment will have the same compliance testing requirements

## Performance-based



- Test assembled equipment

## Design-based



Test separate components



- Test assembled equipment



# Limited Term Certification for Evaporative Components

- Component EOs currently have no expiration
- Components can currently be referenced in certification applications unless the Executive Officer finds that they no longer meet standards
- Limited term certification will ensure
  - components are periodically evaluated
  - components meet current emission standards

# Clarification of Certification Requirements

- Specify requirements for running loss control determination
  - Required if actively-purged carbon canisters are not used
  - Speed up approval process by avoiding confusion
- Refine requirements for preconditioning at elevated temperature
  - For tanks > 0.2 in. thickness used on complete systems
  - For all fuel tanks certified alone
  - Consider requiring the 95 percent confidence interval to be below the standard
  - Require all daily measurements to be below the standard



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# ARB's *Mobile Source Strategy*

October 2015



## Mobile Source Strategy

DISCUSSION DRAFT



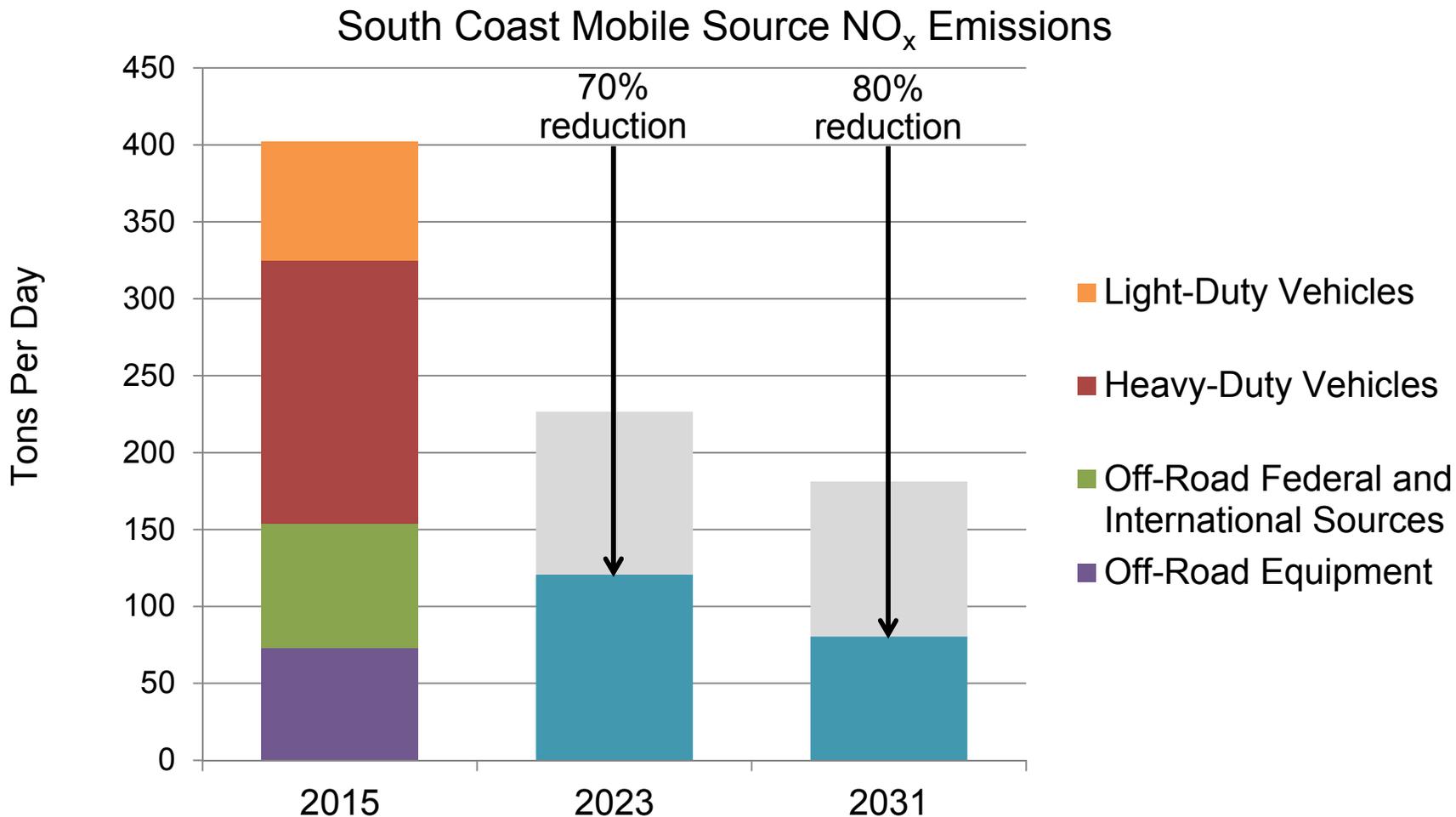
California Environmental Protection Agency  
Air Resources Board

- Workshop in October 2015
- Presented to the Board
- Roadmap for attainment of federal ozone standards
- Multiple air quality and climate goals

# Meeting Multiple Goals



# Significant Emissions Reductions Needed



# *Mobile Source Strategy* SORE Measure Concept

- Goal: Reduce emissions from small off-road engines
  - Tighten exhaust and evaporative emission standards
  - Increase penetration of zero emission technology
  - Enhance enforcement of current emission standards
- Incentivize production and deployment of zero emission technology
- 25 percent replacement of spark-ignited equipment with zero-emission equipment by 2030
- Timeframe:
  - Board Date: 2018
  - Implementation schedule: 2022 - 2030



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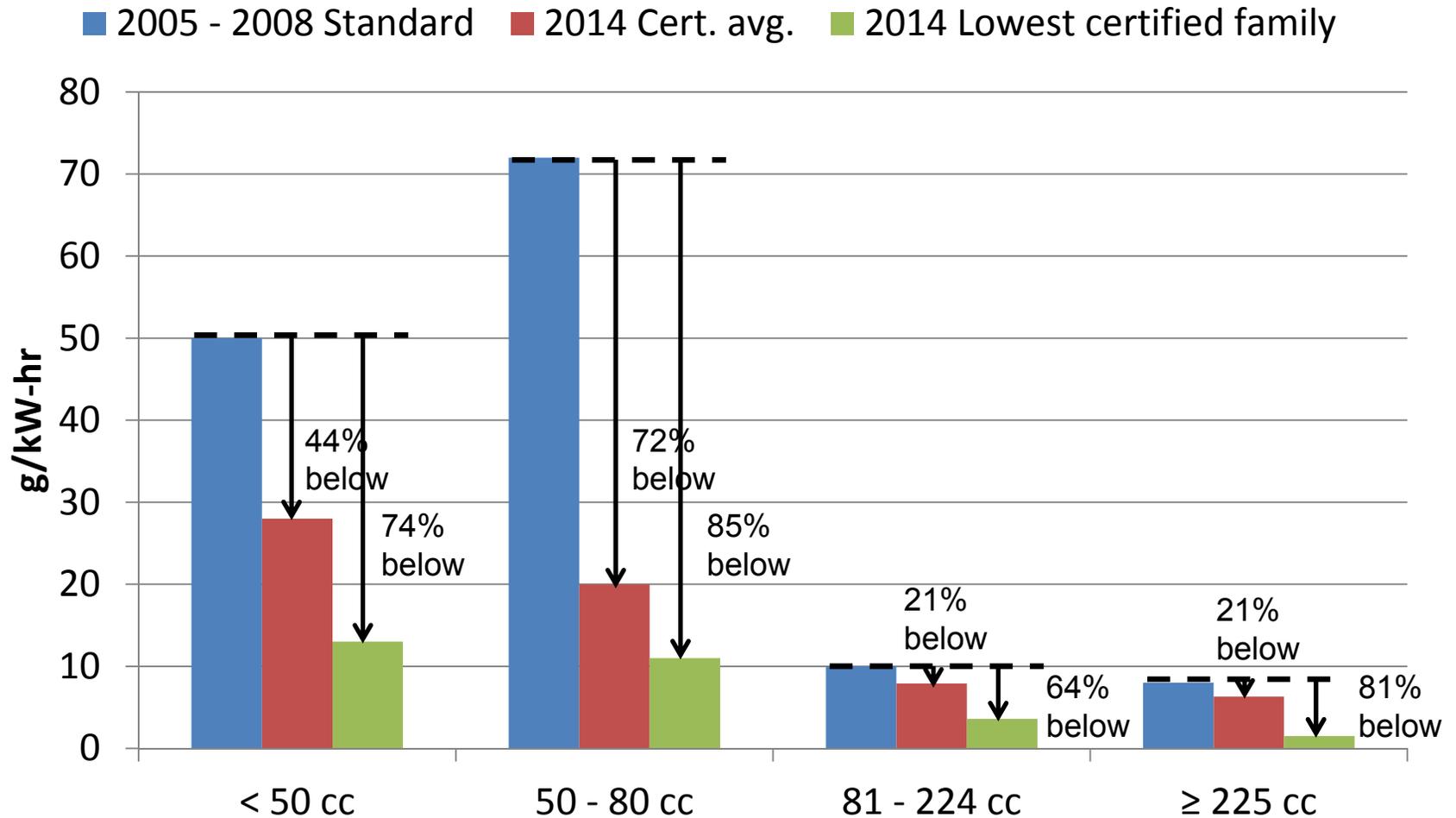
**Development of 2018 Regulatory Proposal**

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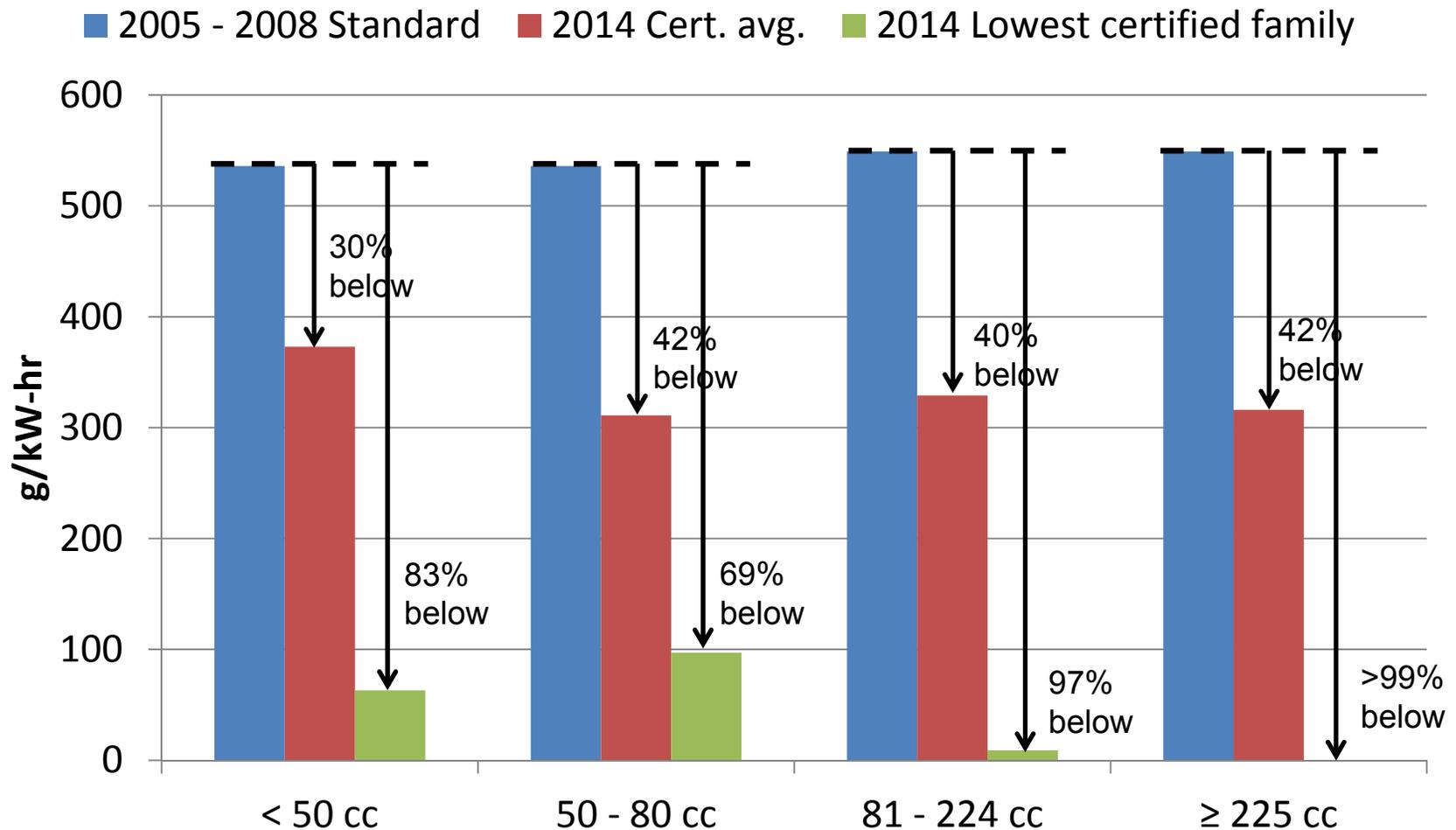
# Lower Emission Standards

- Goal: 80% reduction in HC (exhaust and evap) and NO<sub>x</sub> emissions by 2030
- Consider separate standards for HC and NO<sub>x</sub> in 2022
- Testing will help determine achievable emissions rates
- Engine modification, emission control systems, and averaging could facilitate continued use of 2-stroke equipment

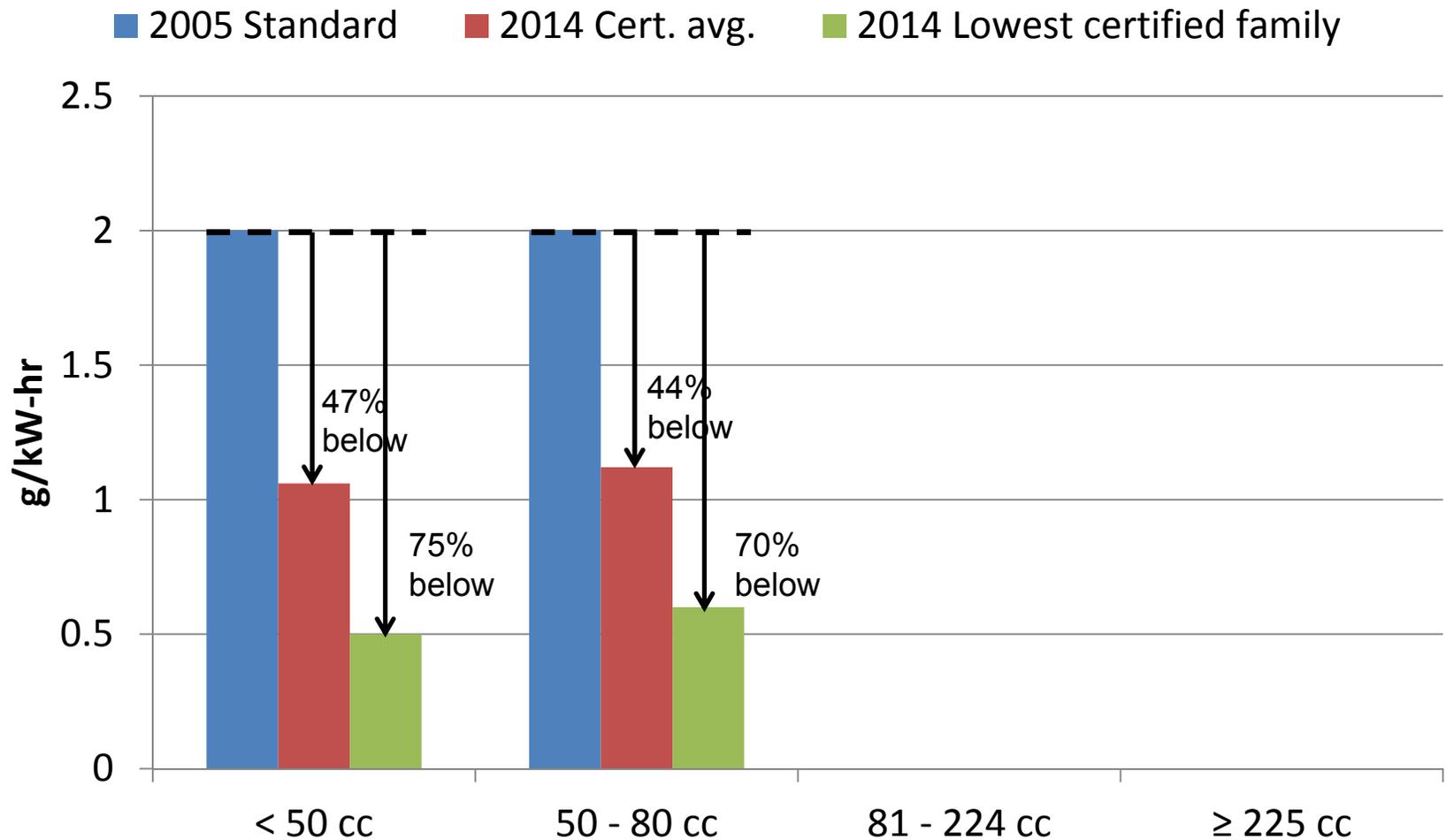
# HC + NO<sub>x</sub> Exhaust Emissions (4-stroke)



# CO Emissions (4-stroke)

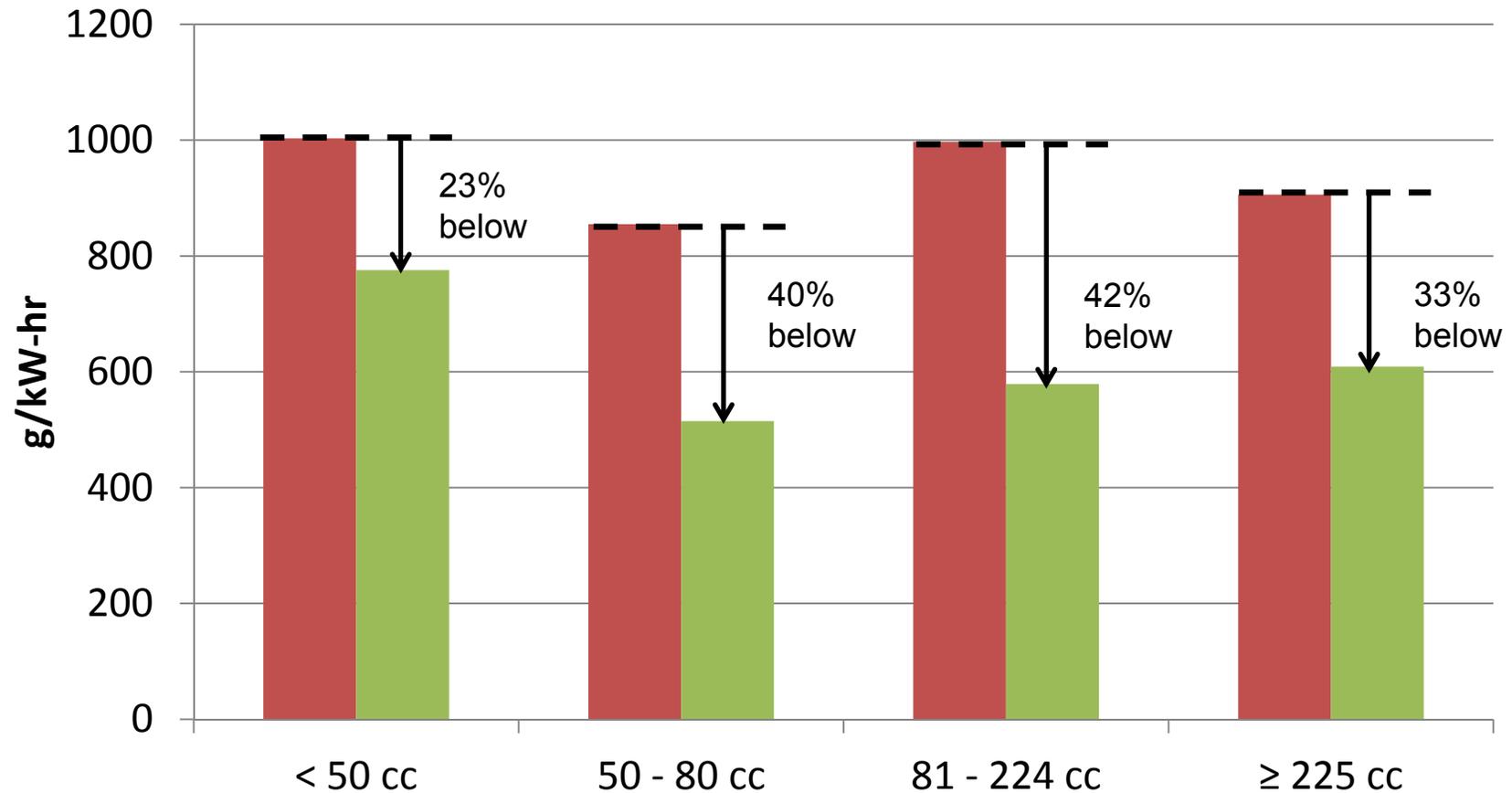


# PM Emissions (2-Stroke)



# CO<sub>2</sub> Emissions (4-Stroke)

■ 2014 Cert. avg.    ■ 2014 Lowest certified family



# Current Evap Emission Standards ( $\leq 80$ cc)

Calendar Year	Unit Diurnal Emissions (g HC/day)	Fuel Hose Permeation (g ROG/m <sup>2</sup> ·day)	Fuel Tank Permeation (g ROG/m <sup>2</sup> ·day)
2007+ (Standard)	None	None	2.0
2015 (Cert. avg.)	NA	NA	0.719

- Only 13 of 62 certified fuel tanks used in 2015 are certified above 1.0 g ROG/m<sup>2</sup>·day
- 8 fuel tanks used in 2015 are certified at or below 0.2 g ROG/m<sup>2</sup>·day

# Current Evap Emission Standards (81-224 cc)

Calendar Year	Performance	Design	
	Unit Diurnal Emissions (g HC/day)	Fuel Hose Permeation (g ROG/m <sup>2</sup> ·day)	Fuel Tank Permeation (g ROG/m <sup>2</sup> ·day)
2009+ (WBM standard)	1.0 (WBM)	15	NA
2012+ (Standard)	$0.95 + 0.056 \times V$ (Other equipment)	15	1.5
2015 (WBM cert. avg.)	0.724 (WBM)	Not calculated	NA
2015 (cert. avg.)	71.1% of standard (Other equipment)	7.6	0.847

WBM = Walk-behind mowers, V = Fuel tank volume (L)

- Only 2 of 10 certified fuel tanks used in 2015 are certified above 1.0 g ROG/m<sup>2</sup>·day
- 1 fuel tank used in 2015 is certified at or below 0.2 g ROG/m<sup>2</sup>·day

# Current Evap Emission Standards ( $\geq 225$ cc)

Calendar Year	Performance	Design	
	Unit Diurnal Emissions (g HC/day)	Fuel Hose Permeation (g ROG/m <sup>2</sup> ·day)	Fuel Tank Permeation (g ROG/m <sup>2</sup> ·day)
2013+ (Standard)	$1.20 + 0.056 \times V$	15	1.5
2015 (cert. avg.)	61.7% of standard	7.7	0.574

V = Fuel tank volume (L)

- Only 5 of 26 certified fuel tanks used in 2015 are certified above 1.0 g ROG/m<sup>2</sup>·day
- 5 fuel tanks used in 2015 are certified at or below 0.2 g ROG/m<sup>2</sup>·day, 13 are below 0.5 g ROG/m<sup>2</sup>·day.

# Zero Emissions Path

- Transition to zero-emission equipment (ZEE) through
  - Market acceptance and demand
  - Incentives for manufacturers – ARB
  - Incentives for consumers – Air Districts
  - Ultra-low emission standards
- Build on existing ARB ZEE framework
- AQIP demonstration projects

# SORE ZEE Actions Completed to Date

- Introduced “Blue Sky” certification – 2003
- SORE ZEE White Paper – 2004
- SORE ZEE informational item presented to Board – 2004
- Adopted ZEE credits for SORE – 2010
- AQIP Commercial ZEE Demonstration Projects – 2011-2013
- SORE Carl Moyer funding – 2013



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# Success Through Collaboration

## ARB

- Update emissions inventory
- Quantify needed emissions reductions
- Conduct technical studies
- Establish emission standards
- Ensure compliance

## Air Districts

- Develop SIPs to attain air quality standards
- Provide and administer incentive funding for ZEE
- Help with technical studies

## Industry

- Develop innovative control technologies
- Share testing results
- Give technical input
- Design and market professional ZEE

# Near-Term Timeline

## Technical Studies

**Apr 2016:**  
Complete evap.  
testing, initiate  
exhaust testing  
(E-10 fuel)

**Jun 2016:**  
Initiate  
population and  
activity survey

**Nov 2016:**  
Initiate control  
technology  
assessment

**Jan 2017:**  
Initiate emissions  
inventory update



**Dec 2015:**  
SORE Working  
Group Meeting

**May 2016:**  
Second public  
workshop, draft  
regulatory language,  
2018 regulatory  
development update

**Oct 2016:**  
Post regulatory  
Documents for  
public comment

**Nov 2016:**  
Board Hearing (E-10  
fuel, certification and test  
procedure amendments)

## Regulatory Process



# ARB Staff Contact Information

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