



March 22, 2005: Fresno, California
March 24, 2005 : Sacramento, California

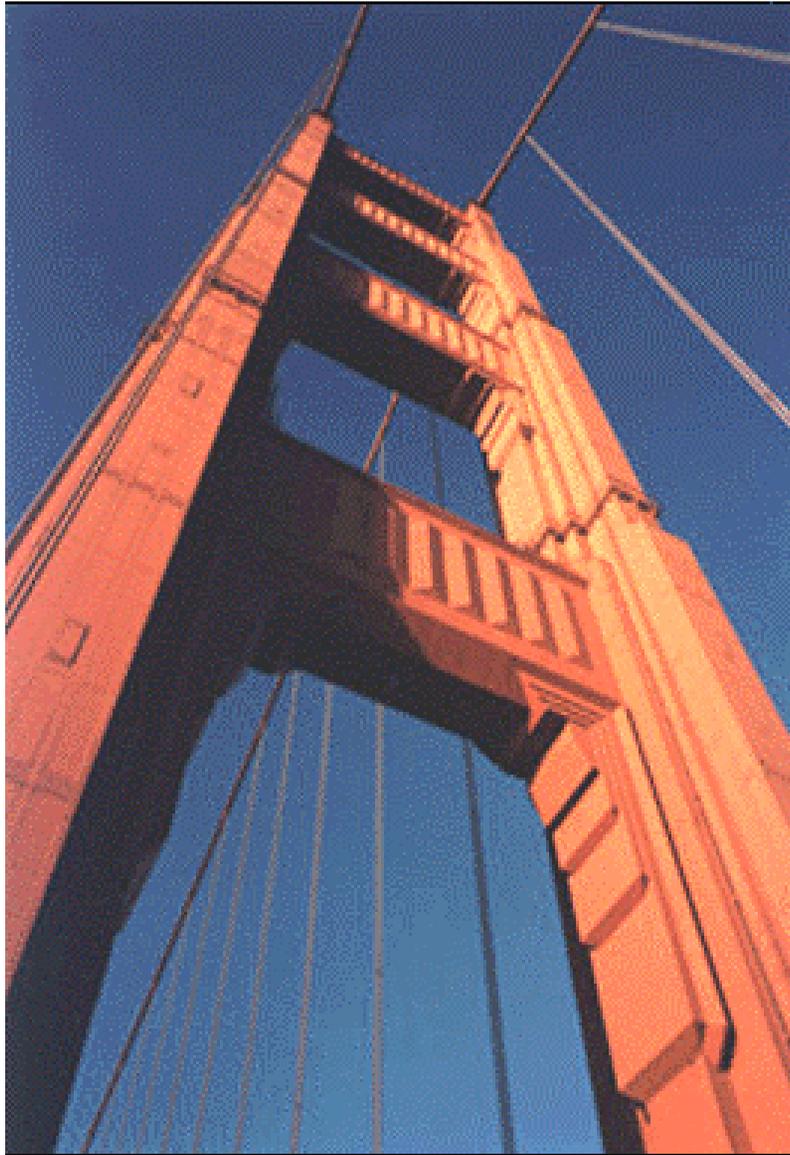
California Environmental Protection Agency



Air Resources Board

Overview

- ◆ Background
- ◆ Regulatory Approach
- ◆ Draft Regulatory Proposal
 - LSI Category
 - User Fleet Average Requirement
 - Proposal for Agricultural Operations
 - Manufacturer Lower Emission Standard
 - Draft Retrofit Verification Protocol
- ◆ Important Dates



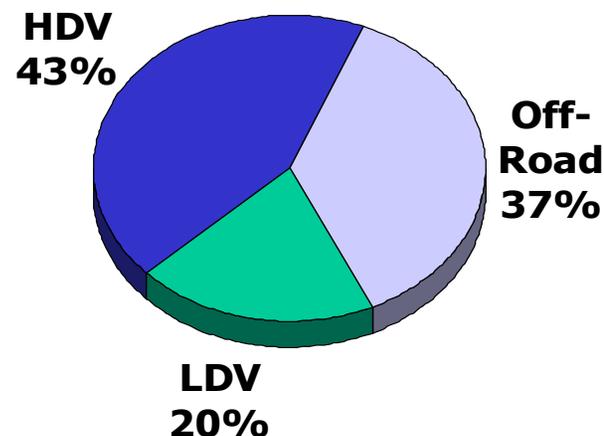
Background

What are LSI Engines?

- ◆ Typically based on automotive engines
- ◆ Operate on gasoline, LPG, or CNG
- ◆ Greater than 25 hp and 1 liter
- ◆ Commonly found in forklifts, airport ground support equipment, and a wide variety of industrial, construction, and agricultural equipment
- ◆ Regulation will apply to most LSI

Off-Road LSI NOx Emissions

- ◆ The majority of NOx emissions come from mobile sources
- ◆ 37 percent of mobile source NOx emissions are from off-road equipment
- ◆ LSI NOx contribution:
 - about 9 percent - or 60 tons per day - in 2000
 - relative contribution increasing

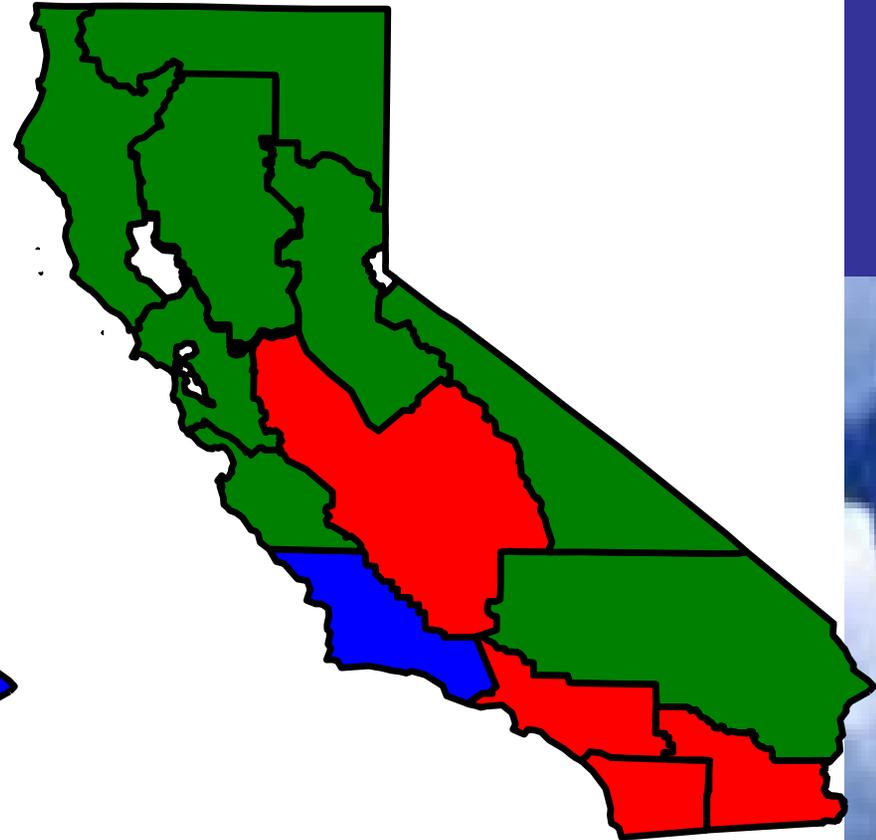
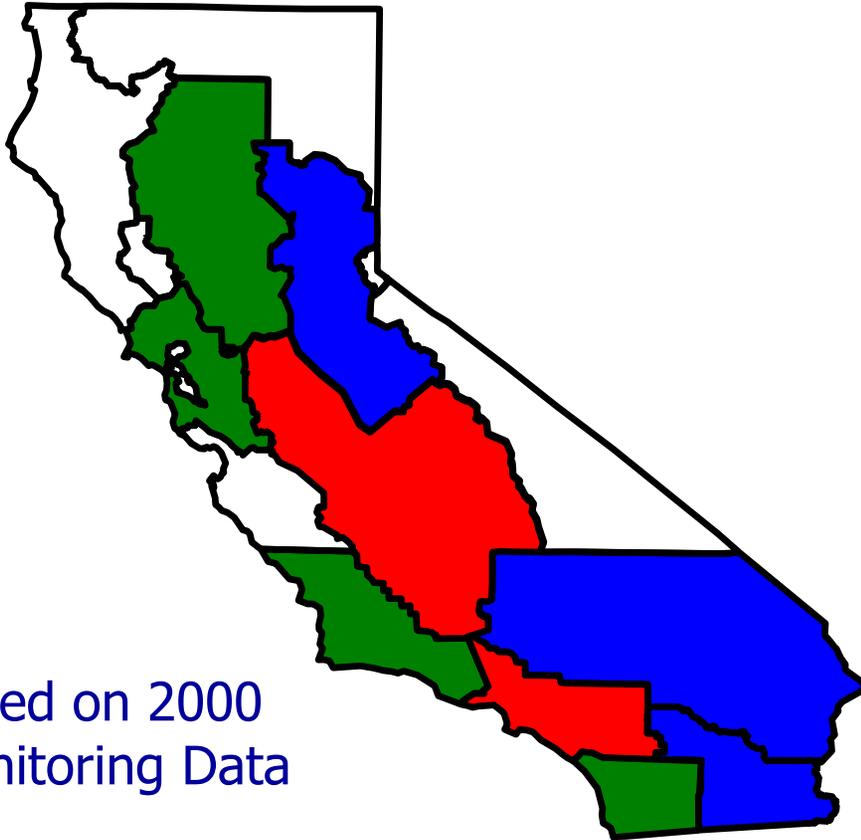


The Air Quality Challenge...

Over 90% of Californians Breathe Unhealthy Air at Times

Days Over State
Ozone Standard

Days Over State
PM10 Standard



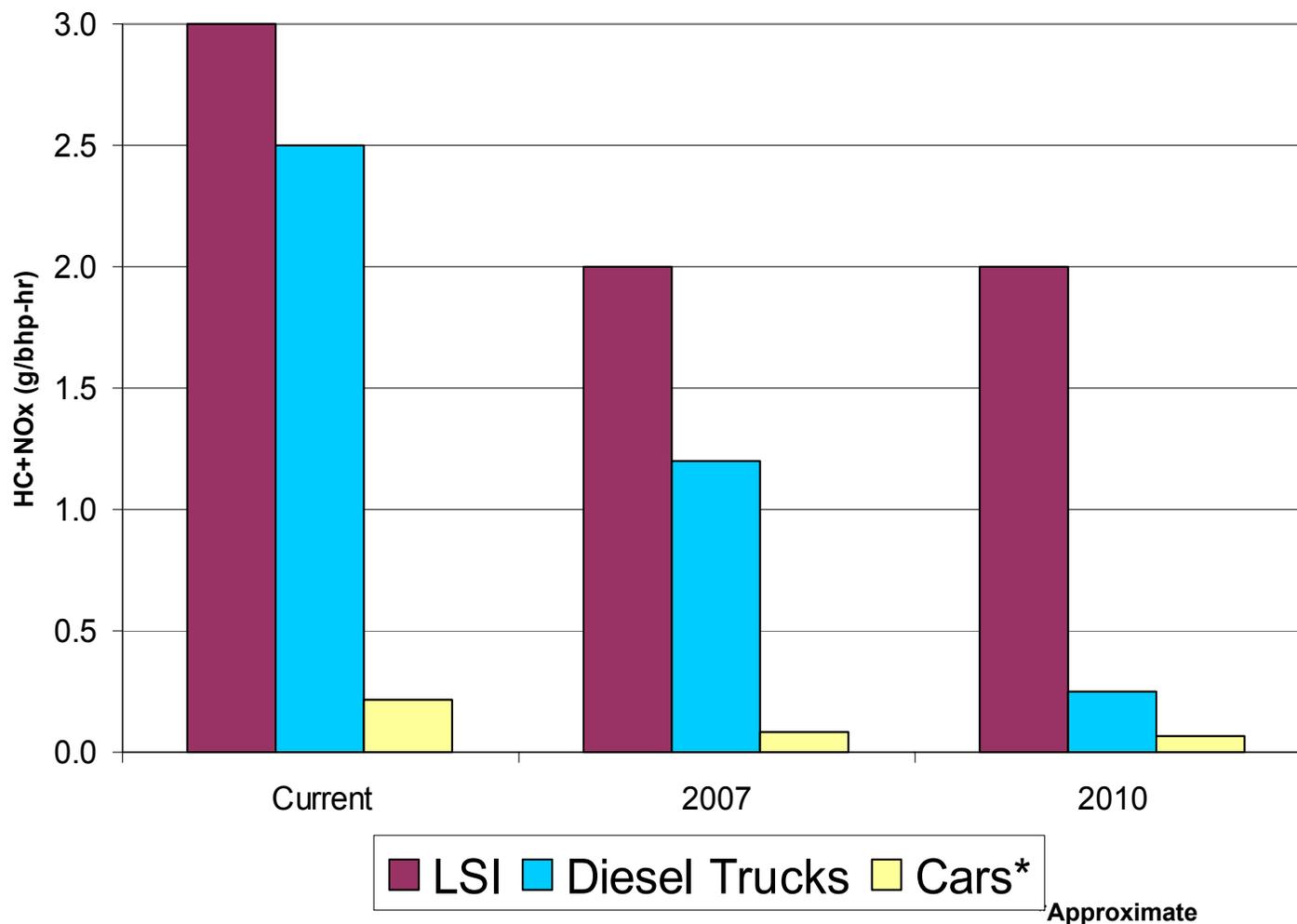
Based on 2000
Monitoring Data



Existing and Pending Regulations

- ◆ 1998 ARB LSI Rule
 - 3.0 g/bhp-hr HC + NO_x certification standard;
 - 2001 -2004 phase in - 25 percent increments
- ◆ 2002 EPA Rule
 - Harmonize with California 3.0 g standard in 2004
 - Set 2.0 g standard in 2007
 - Flexible standards (higher CO/lower HC + NO_x)
 - Requires transient test cycle
 - Optional “Blue Sky” standards
 - 0.6 g/bhp-hr HC + NO_x

Comparative Emissions



Our Commitment in the 2003 State Implementation Plan

- ◆ SIP Measure LSI-1
 - harmonize with 2007 EPA rule
- ◆ SIP Measure LSI-2C
 - consolidates two proposals:
 - Existing engines - reduce emissions by 80%
 - New requirements incorporating zero - and near zero-emission technologies
- ◆ Goal - reduce statewide HC+NO_x 12 tpd

Regulatory Approach



Goals

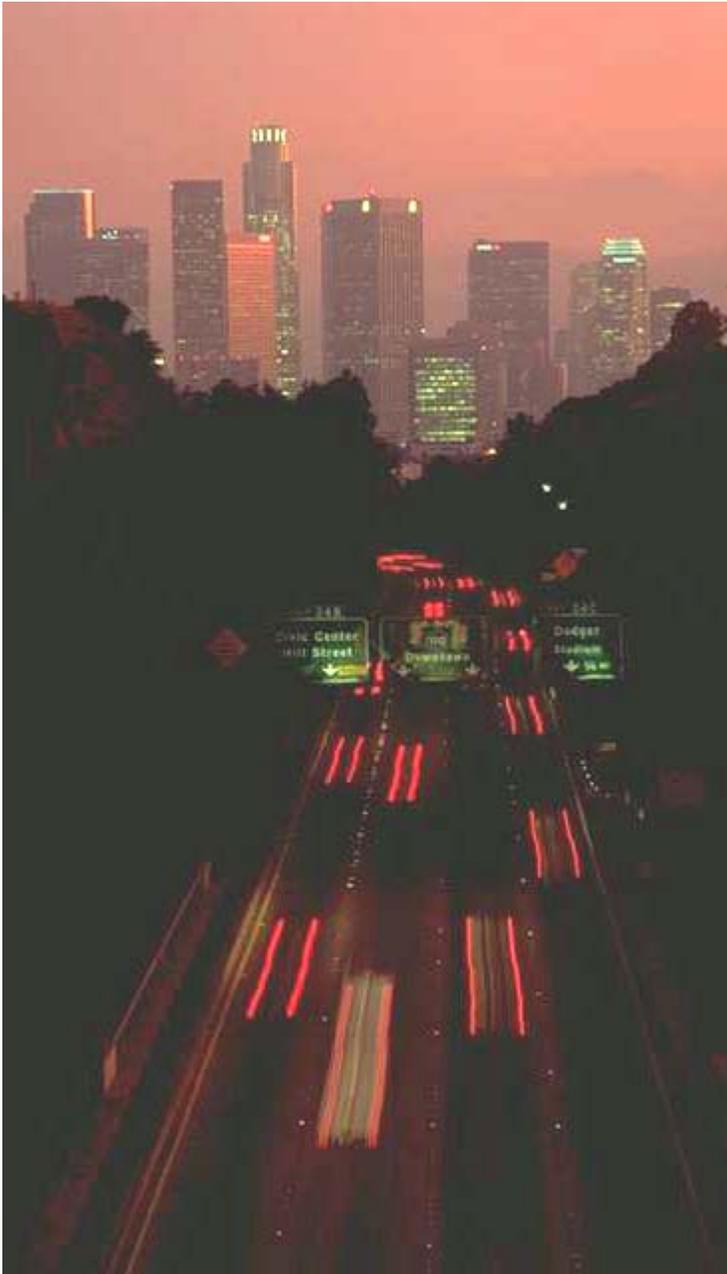
- ◆ **Primary Objectives:**
 - Maximize cost-effective emissions benefits
 - Meet SIP obligations
 - Increase opportunities for zero-emission technology
- ◆ **Additional Goals:**
 - Maximize fleet owner flexibility
 - Ensure enforceable regulations
 - Avoid adverse incentives

Activities to Date

- ◆ Working groups established
 - general LSI group
 - retrofit subgroup
 - includes associations, manufacturers, fleet owners, dealers, and others
- ◆ Workshops
 - May & August 2004 in Sacramento & Los Angeles
- ◆ Commitment to continue dialog

Refining the Proposal

- ◆ Evaluated emission reduction potential of several identified tools
- ◆ Staff proposed three concepts in May:
 - Manufacturer Lower Emission Standard and In-Use Reductions
 - Electric Purchase and In-Use Reductions
 - Owner Fleet Average
- ◆ Two of these three refined / combined in August - basis of today's proposal



Draft Regulatory Proposal

Proposal Elements

- ◆ Fleet Average - medium/large fleets
- ◆ No Uncontrolled Equipment - small fleets
- ◆ Alternative Compliance Path - agricultural fleets
- ◆ Harmonization with U.S. EPA 2.0 g Standard
- ◆ 2010 Manufacturer Lower Emission Standard
- ◆ Optional Low-Emission Standards
 - Optional standards for 2007 and later
 - Voluntary standards for 2005-2006
- ◆ Retrofit Verification
 - Establish levels and procedures

Applicability

- ◆ Fleet Average Applicability
 - Forklifts, sweepers/scrubbers, tow tractors, GSE
- ◆ GSE still to be addressed
 - Expanded MOU?
- ◆ Small Fleet and Agriculture Applicability
 - Forklifts only
- ◆ Manufacturer Applicability
 - Greater than 25 hp and 1 liter displacement
 - not federally preempted

Fleet Requirements

Requirements for users of LSI equipment

User Fleet Average Proposal

- ◆ LSI user
 - possession/use of equipment over 30 days/year
- ◆ Applies to large and mid-size fleets
 - Large fleets = 26 + pieces of equipment
 - Mid-size = 4 -25 pieces of equipment
- ◆ Progressively more stringent emission levels for 2009, 2011 and 2013
- ◆ Larger fleets have more stringent requirements
- ◆ Short and mid-term requirement

Proposed Fleet Average Emission Requirements

LSI Fleet Type	Number of units	By 2009	By 2011	By 2013
Large fleet – forklift component	26 +	2.4	1.7	1.1
Mid-size fleet – forklift component	4-25	2.6	2.0	1.4
Mid-size or Large Non-forklift fleet	N/A	3.0	2.3	1.7
Small fleet	1-3	No Uncontrolled Equipment by 1/1/2011		

Fleet Average Compliance Strategies

- ◆ Zero-Emission Technologies
- ◆ Lower Emission Equipment
- ◆ In-Use Emission Reductions

Zero Emission Technologies

◆ Electric

- Simple / effective way to reduce a fleet average
- No exhaust / evaporative; extremely low upstream (power plant) emissions
- wide variety of environments
- Lower life cycle costs than LSI forklifts
- Fast charging

◆ Fuel Cells

- Multiple demonstrations
- Expected by 2008



Lower Emission Standards

- ◆ “Clean” LSI equipment
 - Below current 3.0 g standard / 2.0 g standard in 2007
 - Readily available / cost-effective emission control technologies
- ◆ Optional standards
 - provide maximum flexibility
 - part of regulatory proposal
 - manufacturers may voluntarily certify early

In-Use Emission Reductions

- ◆ **Uncontrolled Equipment = High Emissions**
 - All pre-2001 and about half of 2001-2003 engines
 - A single uncontrolled engine operating three shifts = cleanest certified car over its entire life
- ◆ **Retrofits**
 - Add-on emission control devices
- ◆ **Repowers**
 - Engine replacement
- ◆ **Replacement**
 - Equipment replacement

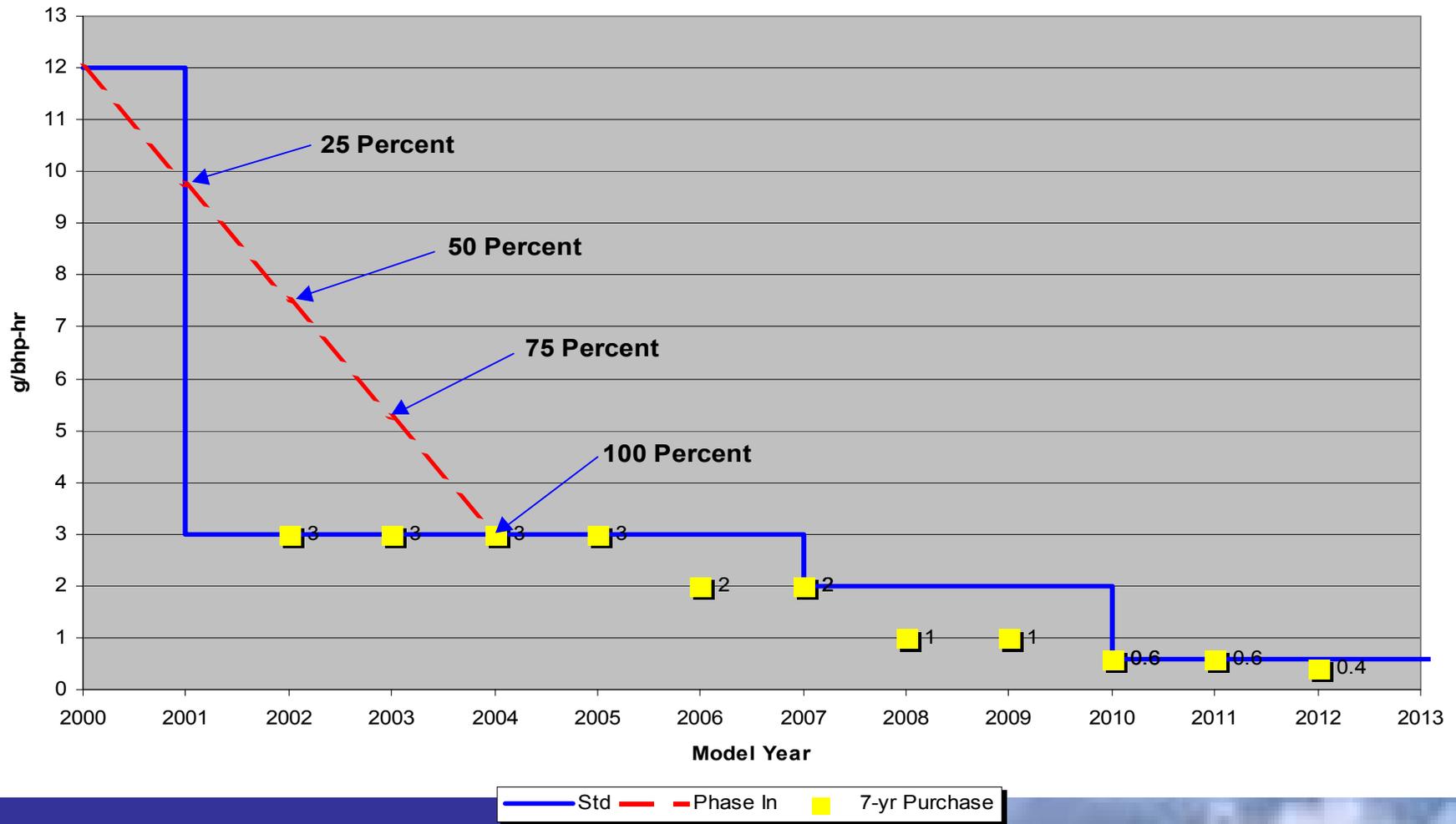
Fleet Average Compliance Examples

Fleet Average Emission Level

- ◆ No uncontrolled equipment
- ◆ Large fleet can attain the 2.4 g/bhp-hr level by:
 - incorporating 11% electric equipment by 2009, or
 - purchasing optional low-emission equipment early:
 - 2.0 g in 2006, 1.0 g in 2008
- ◆ Mid-size fleet - slightly easier compliance meeting 2.6 g/bhp-hr level

Sample Procurement Levels to meet the Fleet Average Levels

LSI HC+NOx Standard



Additional Requirements

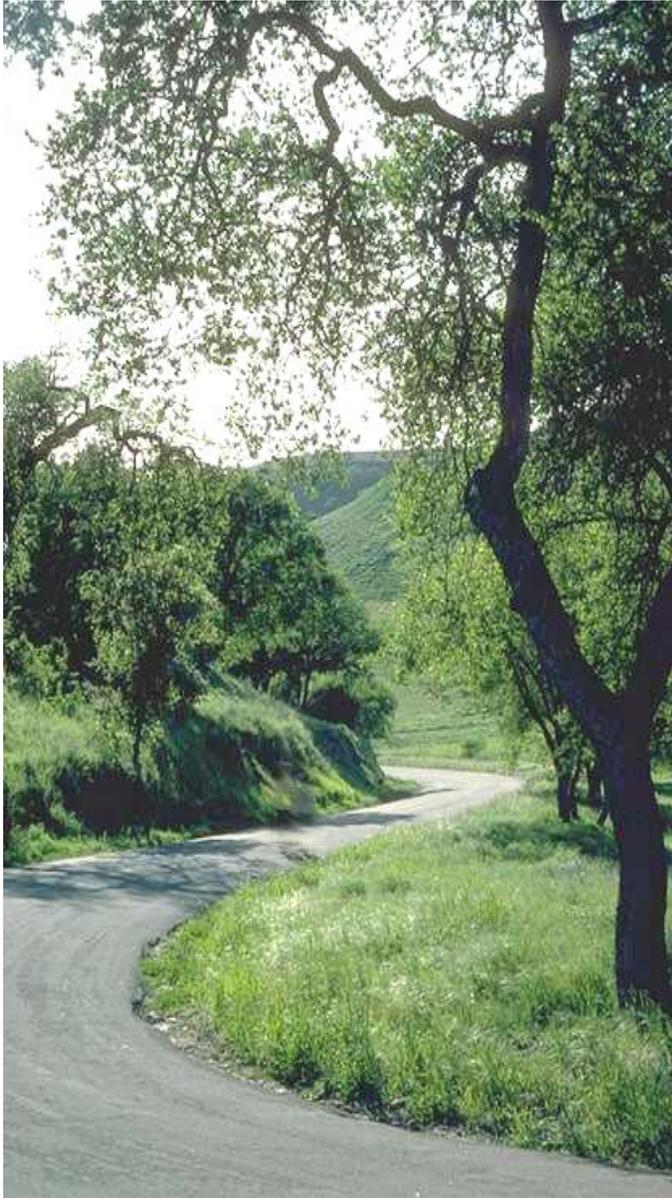
- ◆ Recordkeeping
 - maintain information on equipment type, make, model, serial number, and emission certification level or retrofit verification level
 - through 12/31/2015
- ◆ Rental companies considered fleet users for equipment rented for periods of 30 days or less

Proposal for Small Fleets

- ◆ Fleets of 1-3 forklifts
- ◆ No uncontrolled equipment by January 1, 2011
- ◆ Retrofit, repower, or replace
 - retrofit to a 3.0 g/bhp-hr emission level
 - repower with a 3.0 g/bhp-hr certified engine
 - replace with a new or used piece of equipment certified to the 3.0 g/bhp-hr standard
- ◆ Low usage consideration
 - less than 250 hours per year

Alternative Proposal for Agricultural Operations

- ◆ Owned forklifts only
- ◆ Ten percent of uncontrolled equipment each year for ten years through retrofit, repower, or replacement
- ◆ Decreased regulatory impact (as compared to fleet average)
- ◆ Discussions ongoing: hours of use exemption, durability of the exemption, and reporting



Discussion

Manufacturer Low Emission Standards

Requirements for engine and equipment manufacturers

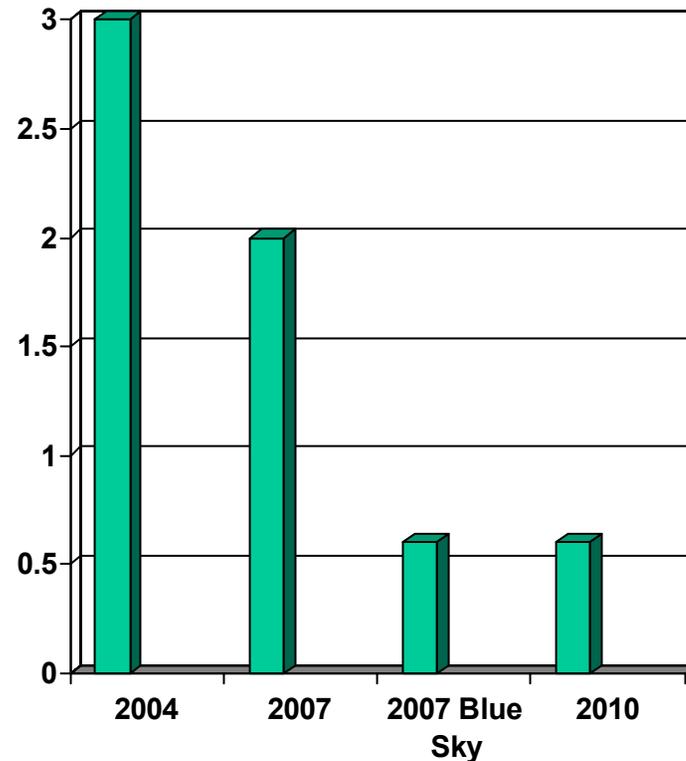
Requirements for Engine & Equipment Manufacturers

- ◆ Harmonization with 2007 EPA Standard
- ◆ 2010 Manufacturer Lower Emission Standard
- ◆ Optional Tiered Standards
- ◆ Voluntary Certification MAC
- ◆ Available Technology
- ◆ Technology Comparison

Manufacturer Lower Emission Standard

HC + NOx Standards

- ◆ Harmonize with EPA 2.0 g/bhp-hr rule
- ◆ Optional EPA 0.6 g “Blue Sky” in 2007
- ◆ Required 0.6 g proposed in 2010
- ◆ Draw upon automotive emission technology



Technology Comparison

	2004 Forklift	Best Case Forklift
Fuel System	Carb/TBI	SMPI
Catalyst Volume (% of engine)	40%	80%
Grams of Pt	0.77	> 2
Grams of Rh	0.19	> 0.4
Cert. Emissions (HC+NOx g/bhp-hr)	1	0.28
Emission Std. (HC+NOx g/bhp-hr)	3.0	3.0

Technology Comparison

	2004 Forklift	Best Case Forklift	Typical 2004 Car
Fuel System	Carb/TBI	SMPI	SMPI
Catalyst Volume (% of engine)	40%	80%	100%
Grams of Pt	0.77	> 2	> 2
Grams of Rh	0.19	> 0.4	~ 2
Cert. Emissions (HC+NOx g/bhp-hr)	1	0.28	0.06*
Emission Std. (HC+NOx g/bhp-hr)	3.0	3.0	0.15*

*Approximate

Optional Manufacturer Lower Emission Standard

- ◆ Optional Tiered Certification
 - Model year 2007 and later
 - Early use of available clean technologies
 - certify to 1.5, 1.0, 0.6, 0.4, 0.2 and 0.1 g/bhp-hr
- ◆ Clean fuel important
 - heavy ends detrimental to control technologies
 - strive to ensure high-quality fuel throughout distribution chain

Voluntary Certification Manufacturer Advisory Correspondence (LSI MAC)

- ◆ MY 2005 and 2006
- ◆ Certify to 2.0, 1.5, 1.0, 0.6, 0.4, 0.2 and 0.1 g/bhp-hr
- ◆ Early use of available clean technologies
- ◆ Two engine families certifying to 2.0 g right now
- ◆ Expect more will follow

Draft Retrofit Verification Protocol

Requirements for manufacturers of
retrofit emission control systems

Need for Retrofit Verification Protocol

- ◆ Currently - No LSI retrofit verification protocol available
- ◆ Verification needed to sell/install retrofit emission systems in California
- ◆ Verification needed to ensure emission reductions are real and durable

Proposed Protocol Overview

- ◆ Manufacturers of retrofits systems for off-road LSI engines
 - any fuel (LPG, gasoline, CNG...)
- ◆ Sets verification levels - certify to a percent reduction or absolute level
- ◆ Includes emission verification testing, in-use compliance, warranty, etc.

Verification Requirements

- ◆ Initial emission test and durability demonstration
- ◆ Field demonstration
- ◆ In-use compliance testing
- ◆ Installation and performance warranty

Retrofit Verification Levels

Proposed LSI Engine Retrofit System Verification Levels

Classification	Percentage Reduction (HC+NOx)	Absolute Emissions (HC+NOx)
LSI Level 1	$\geq 25\%$	Not Applicable
LSI Level 2	$\geq 75\%$	3.0 g/bhp-hr
LSI Level 3a	$\geq 85\%$	0.5, 1.0, 1.5, 2.0, 2.5 g/bhp-hr
LSI Level 3b	Not Applicable	0.5, 1.0, 1.5, 2.0 g/bhp-hr

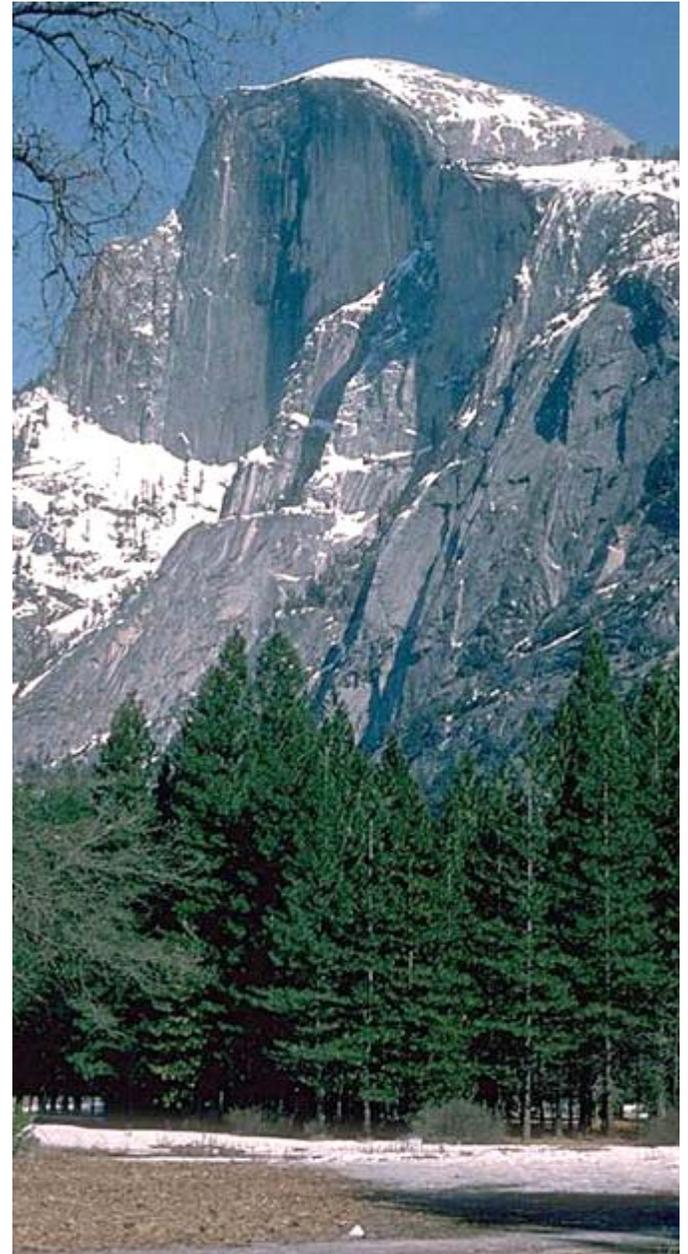
Benefits of ARB-Verified Retrofit Kits

- ◆ Properly engineered, tested, and manufactured
- ◆ Designed for specific equipment
- ◆ Reduce emissions, worker exposure
- ◆ Labeled with verified emission level
- ◆ Warranted for 3 years or 2,500 hours
- ◆ Eligible for incentive funds

Interim Verification

- ◆ Manufacturers can verify systems prior to regulation fully operative
- ◆ Early availability of retrofit kits
- ◆ Kits can be used to comply with user Fleet Average
- ◆ Kits would be fully warranted
- ◆ Eligible for incentive funds

Estimated Benefits of the Proposal



Statewide Emission Reduction Benefit

Staff Proposal Element	HC+NOx Emission Reductions (tons per day)	
	Year 2010	Year 2020
Fleet Average Emission Requirements ¹	9.0	6.0
Retrofit Requirements ²	1.1	0.0
0.6 g/bhp-hr Engine Emission Requirement	1.5	1.6
Total	11.6	7.6

1. These requirements apply to fleets with 4 or more pieces of off-road LSI equipment.
2. These requirements apply to fleets with fewer than 4 pieces of off-road LSI equipment.

Important Dates

- ◆ May 6, 2005 Staff Report released
- ◆ June 23-24, 2005 Board Hearing

FOR MORE INFORMATION

LSI Activity website address:

<http://www.arb.ca.gov/msprog/offroad/orspark/orspark.htm>

Contact for Draft Proposal:

Jack Kitowski: jkitowsk@arb.ca.gov

Mark Williams: mwilliam@arb.ca.gov

Contact for Draft Retrofit Verification Protocol:

Bob Nguyen: rnguyen@arb.ca.gov

Robin Myers: rmyers@arb.ca.gov

