

Control Measure to Reduce Emissions from Forklifts and Other Industrial Equipment



May 25-26, 2006: Sacramento, California

What are “Large Spark-Ignition Engines”?

- Gasoline and LPG
- Older automotive technology
- Greater than 25 hp and 1 liter
- Typical life of 7-11 years

Examples of LSI Equipment

- Forklifts



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- Airport ground support



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- Sweepers/scrubbers



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- Turf care equipment



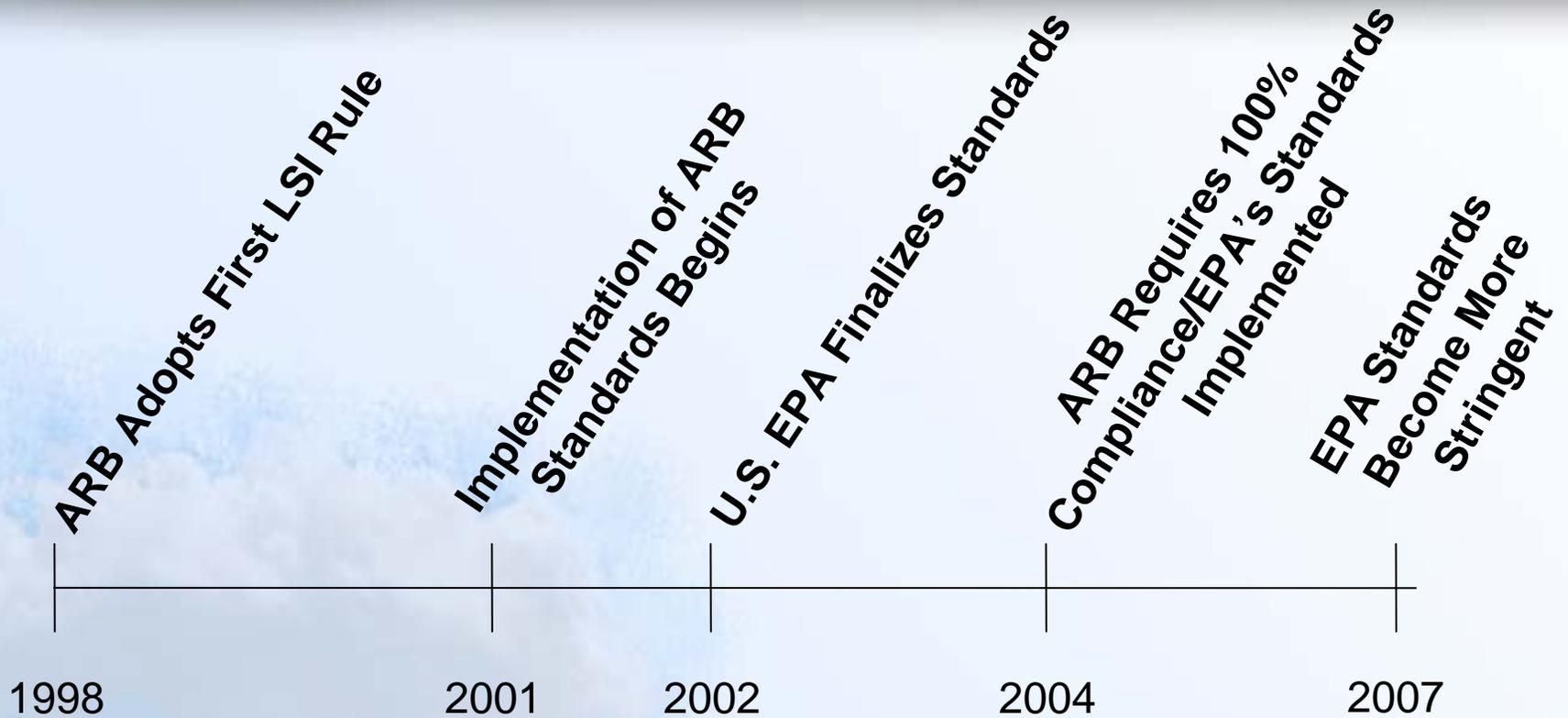
Examples of LSI Equipment

- Forklifts
- Airport ground support
- Sweepers/scrubbers
- Industrial tow tractors
- Generator sets
- Turf care equipment
- Other non-preempted industrial, construction, and agricultural equipment

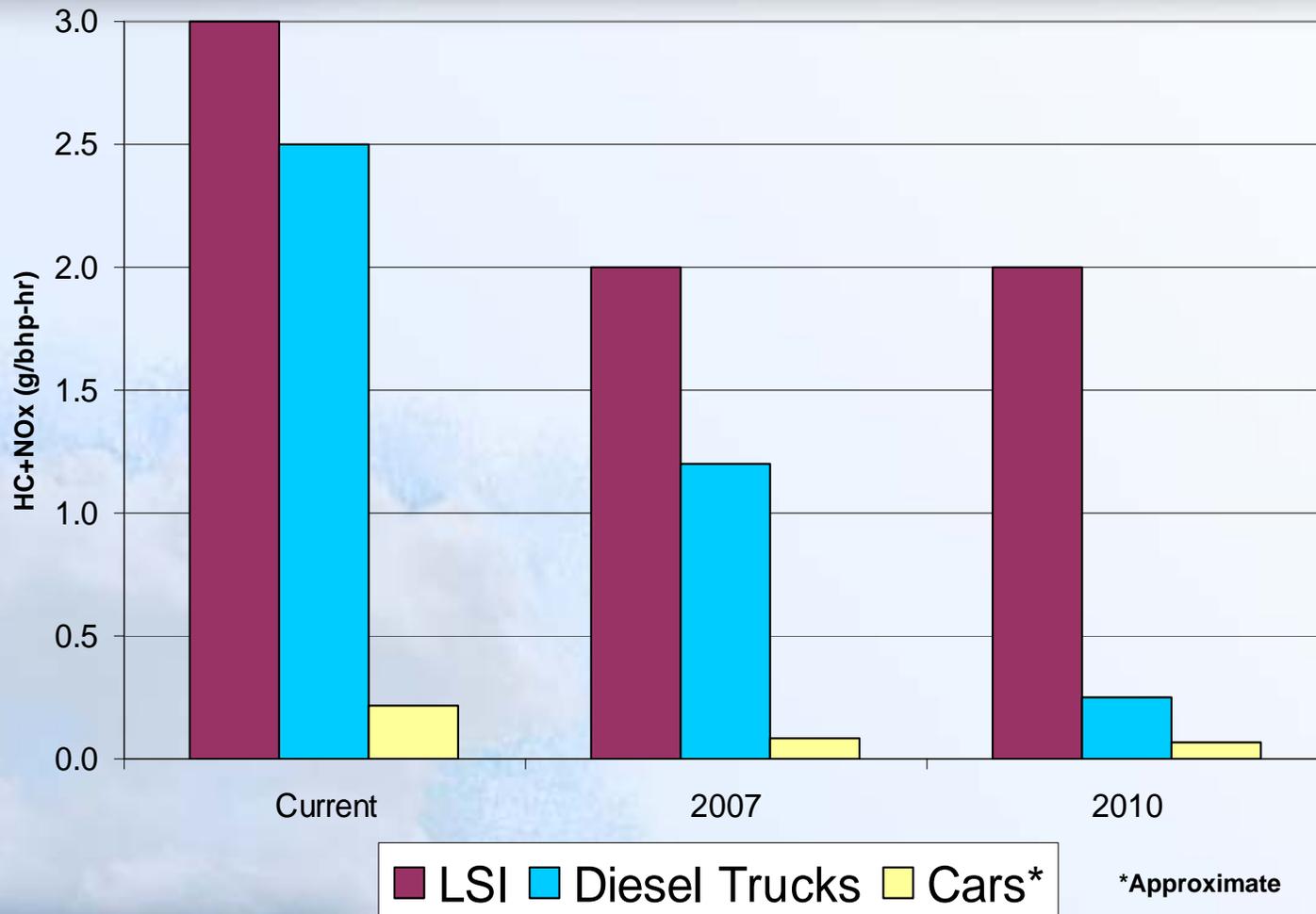
LSI Emissions

- 88,000 LSI engines
 - 40,000 forklifts
- HC+NO_x emissions:
 - 70 tons per day in 2004
 - about 5 percent of off-road mobile source emissions

History of Control



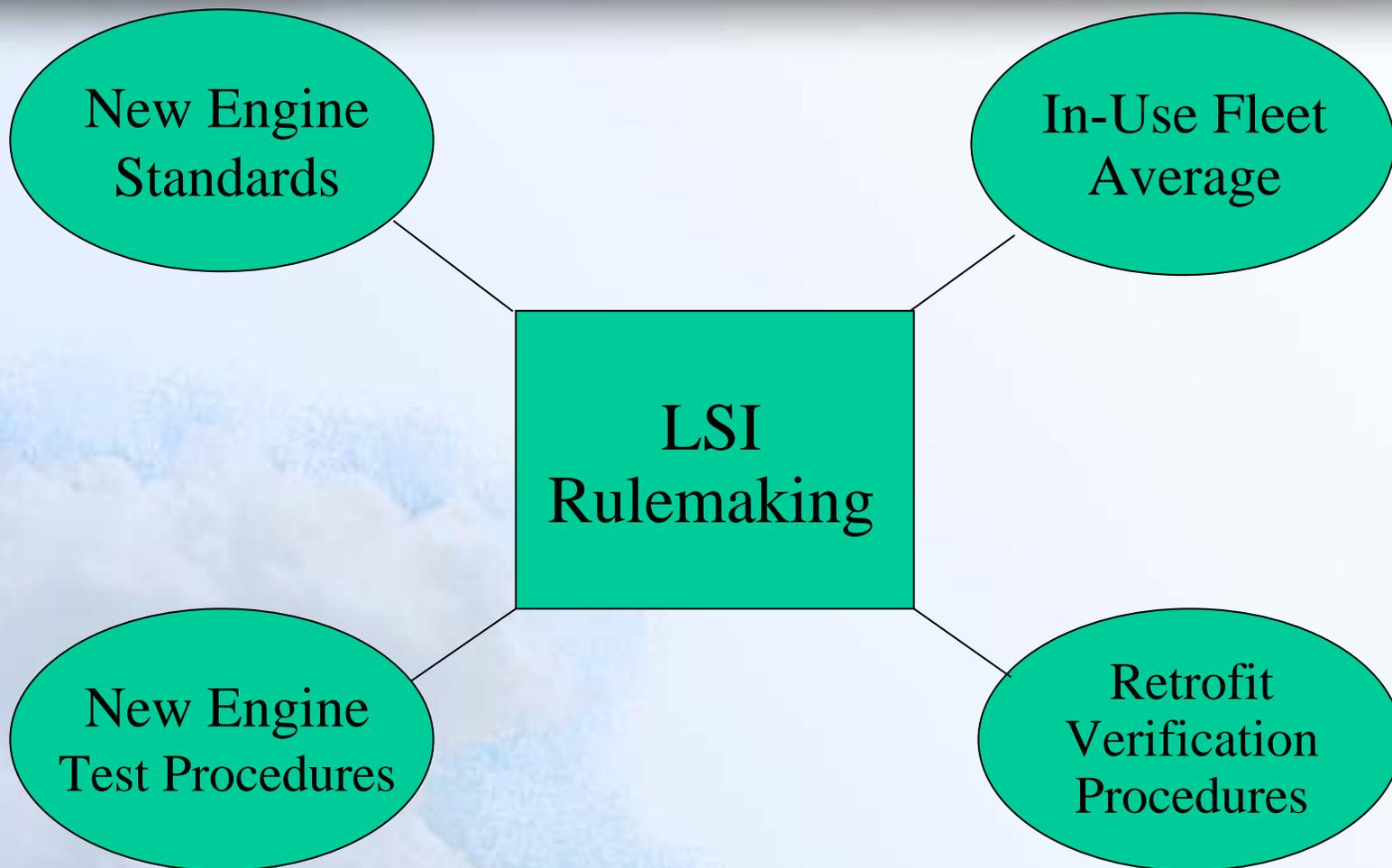
Comparative Emissions



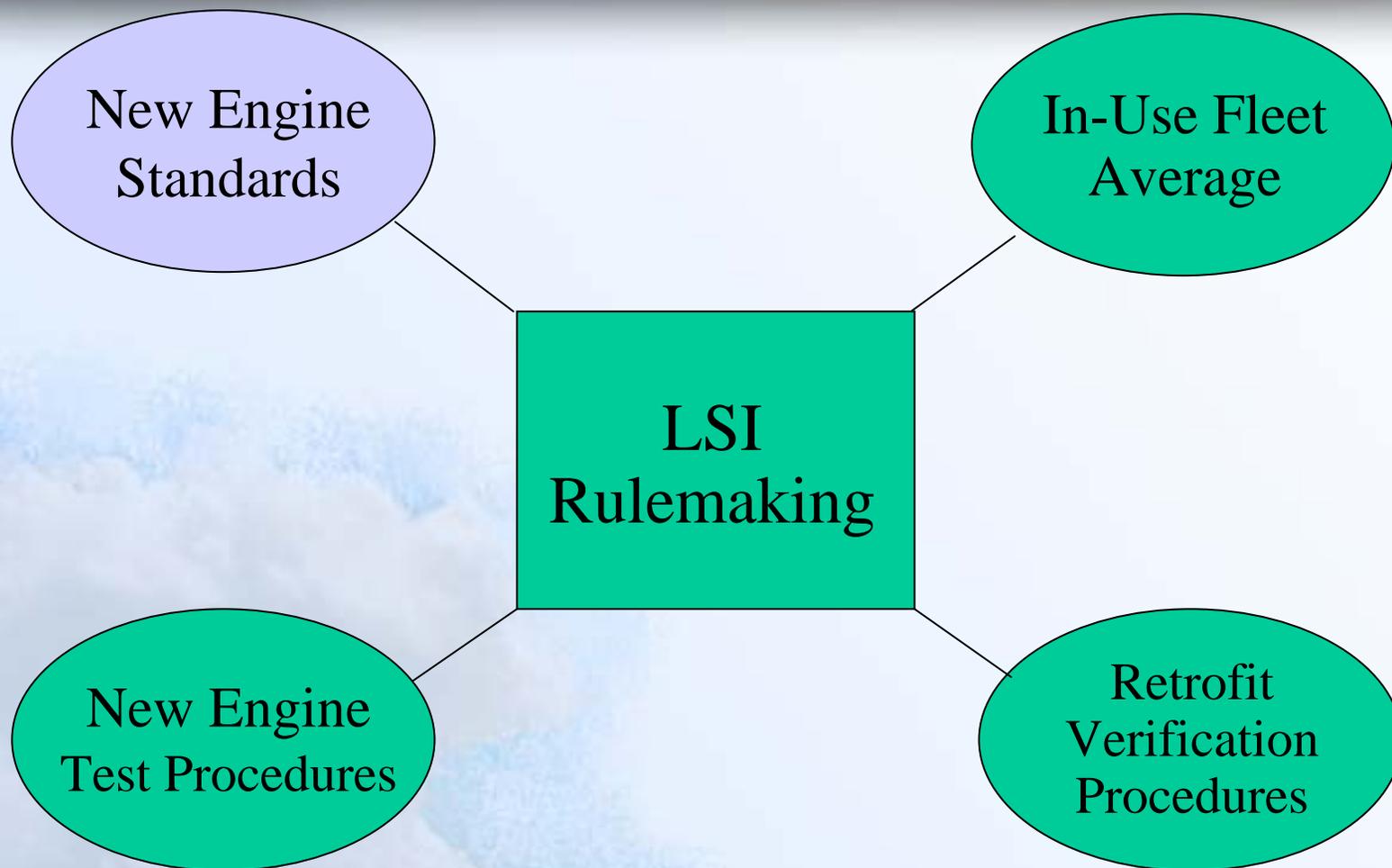
2003 State Implementation Plan Commitment

- SIP Measure LSI-1
 - harmonize with 2007 EPA new engine standards
- SIP Measure LSI-2C
 - Existing engines - reduce emissions by 80%
 - Incorporate zero- and near-zero-emission technologies
- Reduce statewide HC+NO_x emissions
 - 6 to 13 tons per day by 2010

Elements of the Proposal



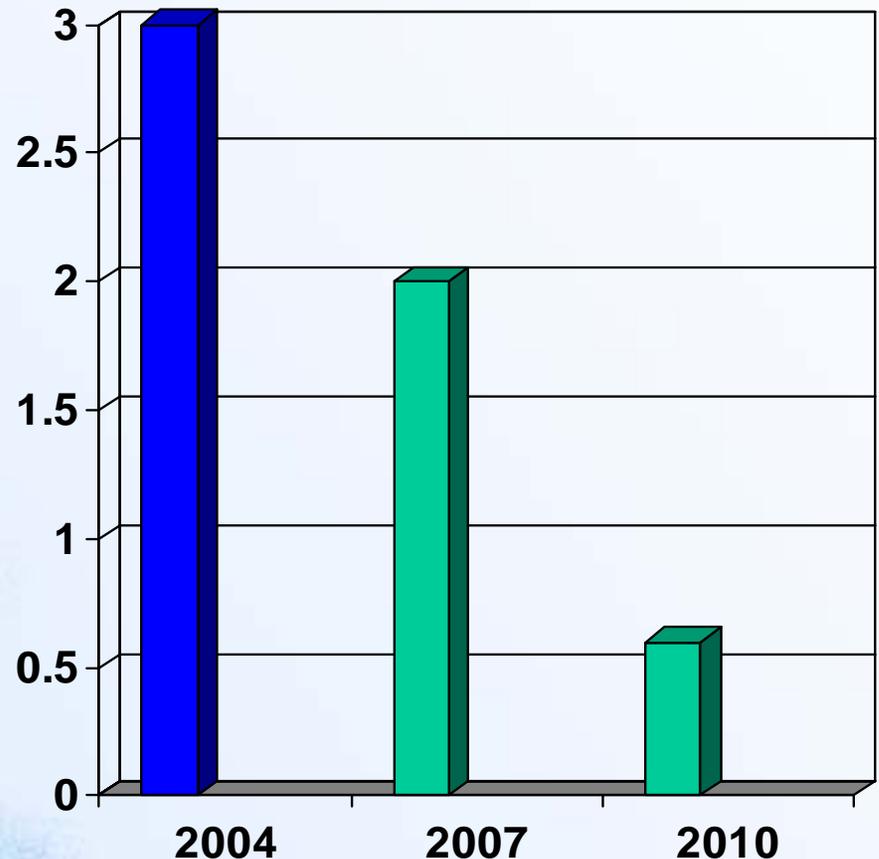
Elements of the Proposal



Proposed New Engine Standards

- 2.0 g/bhp-hr HC+NO_x in 2007
 - Aligns with EPA
- 0.6 g /bhp-hr HC+NO_x in 2010
 - Draw upon automotive emission control technology

HC + NO_x Standards



Technology Comparison

	2004 Forklift	2010 Forklift*	Typical 2004 Car
Fuel System	Carb/TBI	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	0.1 – 0.3	0.06**
Emission Std. (HC+NOx g/bhp-hr)	3.0	0.6	0.15**

*Based on cleanest model available today

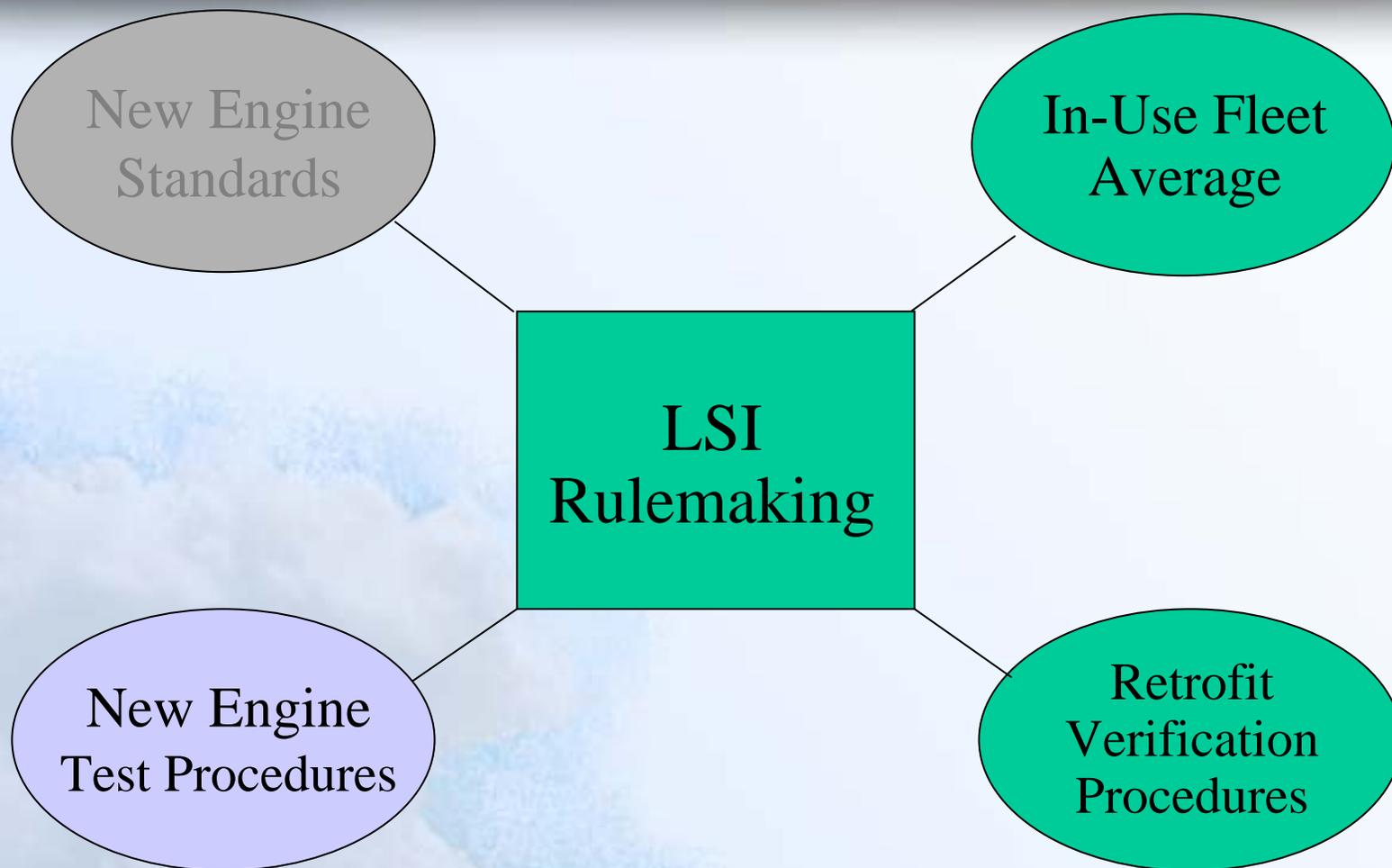
**Approximate

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
 - Credits



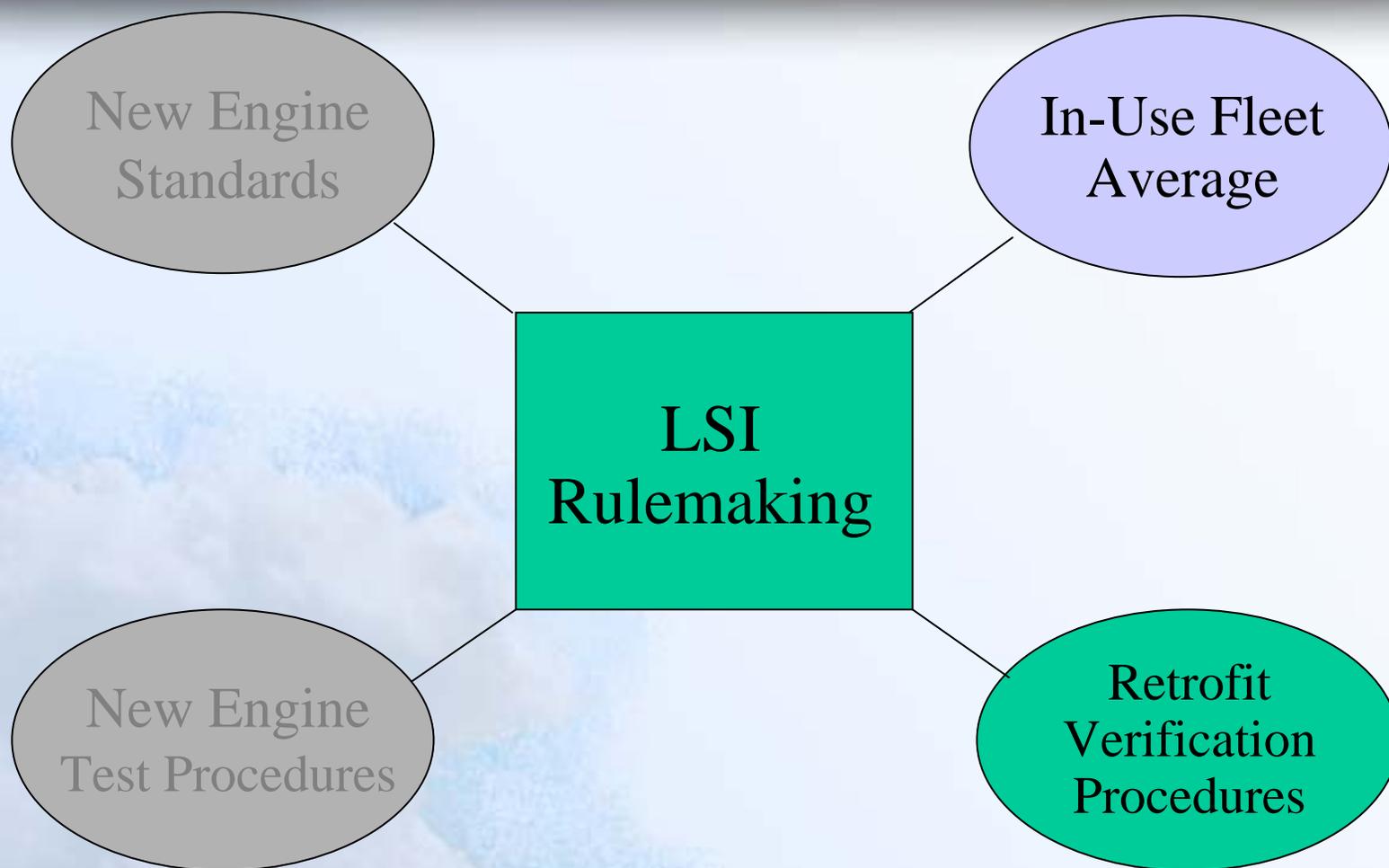
Elements of the Proposal



New Engine Test Procedures Beginning in 2007

- New EPA test procedures in 2007
- Proposal aligns with federal test procedures and compliance provisions:
 - Transient test procedure in 2007
 - Near complete alignment from 2007 - 2009
 - Typical differences in 2010 and beyond
 - Keep more stringent or protective ARB language
 - In-use compliance and auditing
 - Warranty and labeling

Elements of the Proposal



In-Use Fleet Average Concept

- **Uncontrolled Equipment = High Emissions**
 - All pre-2001 and about half of 2001-2003 engines
 - An uncontrolled forklift operating three shifts = cleanest certified car over its entire life
- **Retrofit, replace, or retire**
 - Ensures turnover
 - Control or replacement of uncontrolled engines

In-Use Fleet Average Proposal

- Establishes declining fleet average levels
 - Retrofit or replace uncontrolled equipment by 2009
 - Replace some LSI with zero or near-zero emission equipment
- Applies to
 - operators of forklifts, sweepers/scrubbers, tow tractors, and airport ground support equipment
 - owned equipment; rental/lease greater than one year

In-Use Fleet Average Standards

(Fleet Average Emission Level in Grams HC+NOx)

LSI Fleet Type	Number of units	By 1/1/2009	By 1/1/2011	By 1/1/2013
Large fleet – forklift component	26 +	2.4	1.7	1.1
Mid-size fleet – forklift component	4-25	2.6	2.0	1.4
Non-forklift fleet	N/A	3.0	2.7	2.5

In-Use Fleet Average Compliance Strategy

- Clean up uncontrolled equipment
 - Retrofit control technology exists
 - Available since mid-1990's
 - Two systems verified
 - ~ 90 percent emission reduction
 - Applicable to most 1990 and newer LSI engines
 - ~ \$3,500 installed
 - Improved fuel economy
- Purchase lower-emission equipment
 - New or used equipment certified to optional lower-emission standards



In-Use Fleet Average Compliance Strategy

- **Electric**
 - Commercially available
 - Increasingly capable
 - \$2,000 – \$5,000 more than a comparable LSI lift
 - Lower life cycle costs
- **Fuel Cell**
 - Commercialization has begun
 - Eliminates battery issues



In-Use Fleet Average Modifications

- June 2005 Board feedback
 - Reduce economic impact on dealers and agricultural businesses
 - Find funds to reduce compliance cost
 - No external funding secured
- Staff works with stakeholders to modify proposal
- Modifications identified
 - Significantly lower compliance cost
 - Some loss of emission benefit
 - Consistent with Board direction



Modifications to Staff Proposal

(made since June 2005)

- Forklift dealers
- Agricultural operations
- Airport ground support equipment (GSE)
- Engines less than 1 Liter

Dealers - Revised Proposal

- Original Proposal
 - Dealers could be responsible for clean-up of vehicles coming off current leases
 - Costs high – not planned - not recoverable
- Revised proposal
 - Exempt small fleets from reg. (1-3 units)
 - Provides dealers with a sales outlet for used equipment coming off lease
 - Reduces costs to dealers
 - 1 ton/day less emission reduction (2010)

Agricultural Operations – Revised Proposal

- Original Proposal
 - Reduce emissions of 10% of fleet per year
 - 3 g/bhp-hr level
 - Many old forklifts – only option is replacement at higher cost
- Revised Proposal
 - Only 1990+ forklifts that can use a retrofit kit subject to rule
 - Delayed implementation
 - Cost reduced by 90-98%
 - 0.4 ton/day less emission reduction

Airport GSE Equipment Revised Proposal

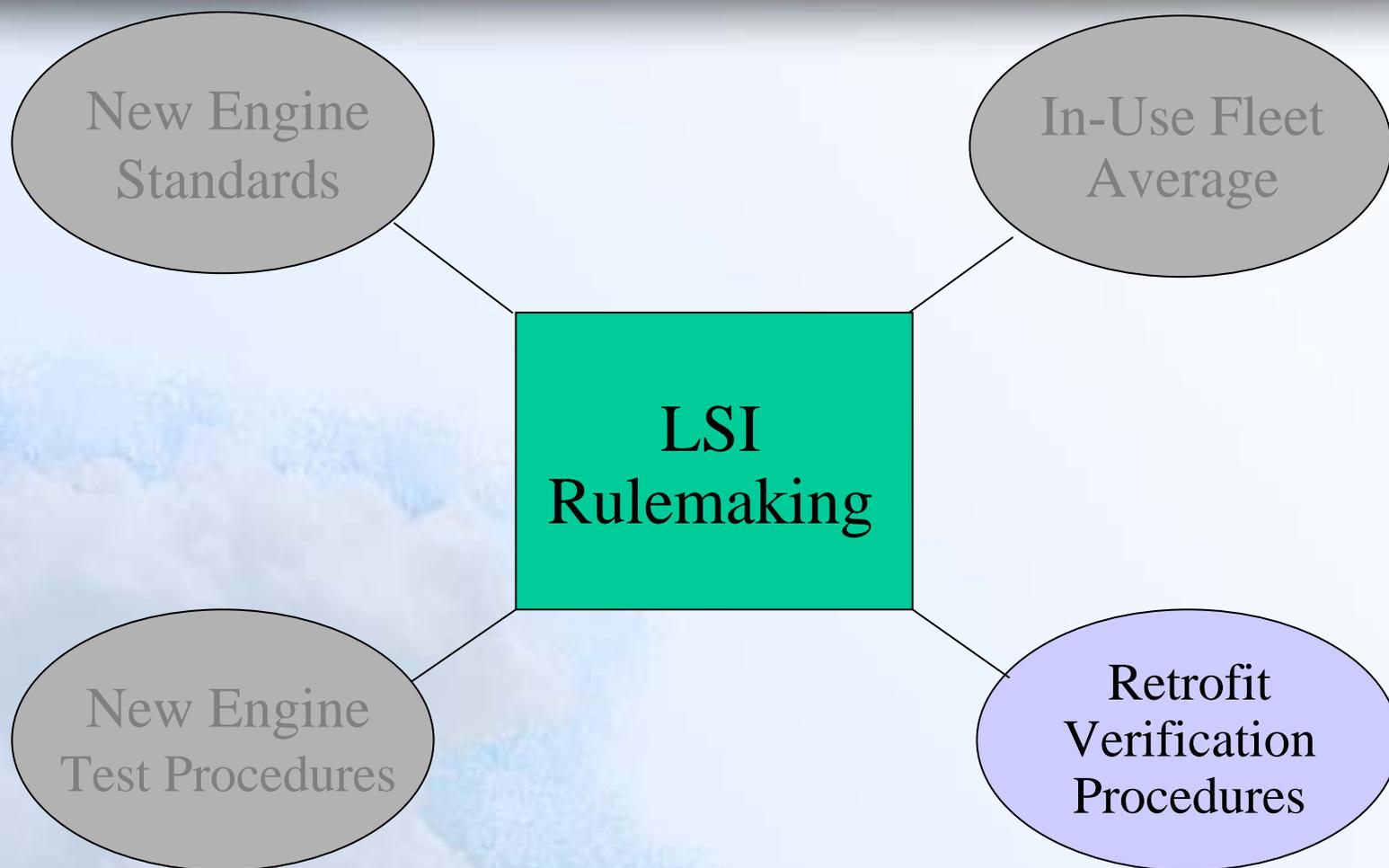
- Original Proposal
 - Airlines in LA must have 30% of fleet zero emission (e.g. electric baggage carts)
 - Proposed regulation replaces MOU terminated by airlines in 2005
- Revised Proposal
 - Eliminate zero emission requirement
 - Airline recently demonstrated they already comply



Engines Less Than 1 Liter Revised Proposal

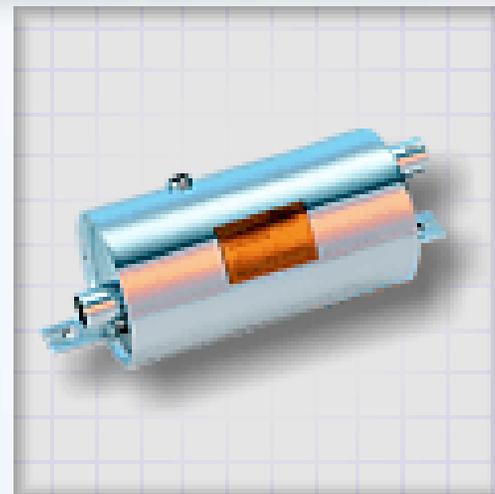
- Original Proposal
 - Not subject to proposed new standards or fleet requirements
 - Allow optional compliance with lawn and garden standards and procedures
 - Simpler test
- Revised Proposal
 - Defer until determined if further emission reductions possible
 - Return to Board with proposal

Elements of the Proposal

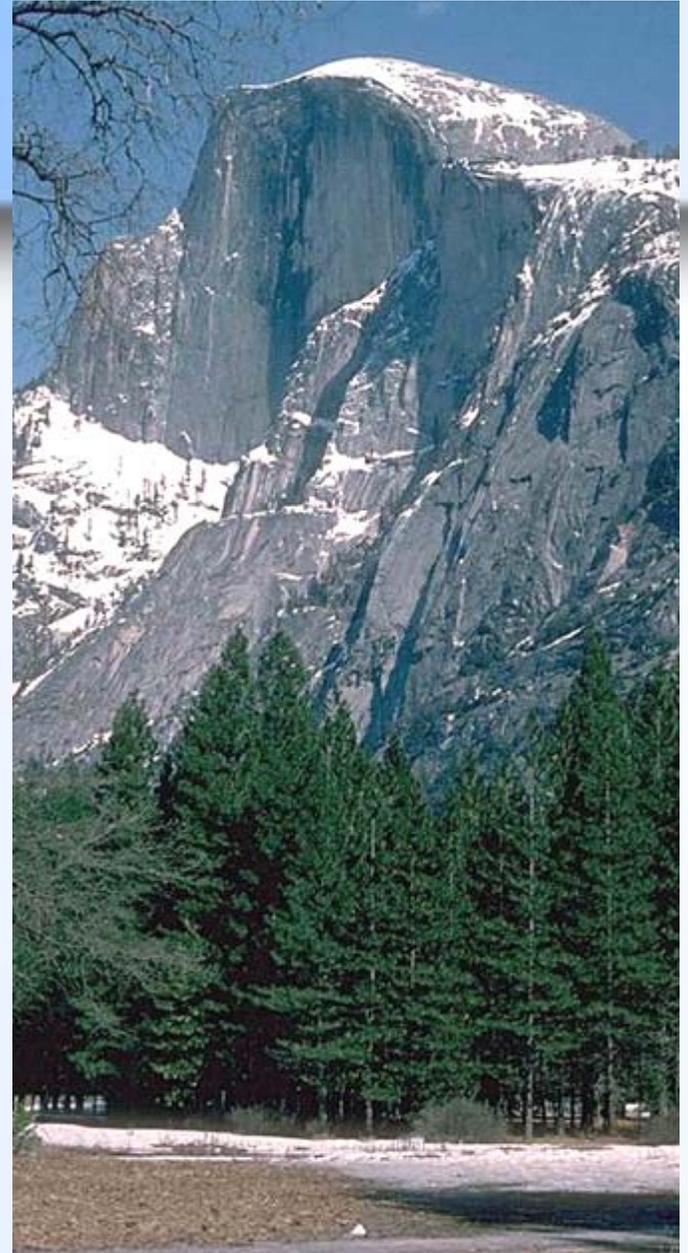


Retrofit Verification

- Verify emission reductions
 - Percentage reduction
 - Absolute emission level
 - Ranges from 0.5 to 3.0 g/bhp-hr
- Field demonstration
- In-use compliance testing
- Installation and performance warranty
 - 3 years or 2,500 hours
- Labeling requirement
- Two retrofit kits verified



Estimated Benefits and Cost Effectiveness of the Proposal



Emission Benefit

Emission Reductions (HC+NOx)

Benefit (tpd)	2010	2020
Original Proposal	7.2	6.6
New Proposal	5.6	6.2
SIP Commitment	6.1 –13.0	3.3 to 11.1

Cost-Effectiveness

Proposal Element	Dollars per Pound
New Engine Standards	0.13
In-Use Requirements:	
Retrofit	0 – 1.00
Zero-Emission	0 – 1.40 ¹

1. Cost-effectiveness based on replacement of both controlled and uncontrolled equipment.

Issues

- 2010 standards for new engines
- Fuel quality

Issue – 2010 New Engine Standards

- Issue: Feasibility of the 2010 standards
 - Stringency
 - Lead time
- ARB staff response:
 - 2010 standards achievable:
 - Better emission controls available
 - One engine tested at 0.7 g/bhp-hr
 - Cars currently emit at $\frac{1}{4}$ the 2010 standard

Issue – Fuel Quality

- Issue: Manufacturer concern with LPG fuel quality
 - Impact of poor fuel quality on engine performance
- ARB staff response: Continue to evaluate
 - Data collection
 - Contract in process
 - Report to Board as necessary

Conclusions

- Significant emission reductions
- Proposed modifications:
 - Reduce costs
 - Result in some loss in emission benefit
- Standards are attainable with existing technologies
- Staff recommends Board adoption with proposed modifications