Tier 4 Regulations for Off-Road Diesel Engines and Equipment

Air Resources Board Hearing
December 9, 2004

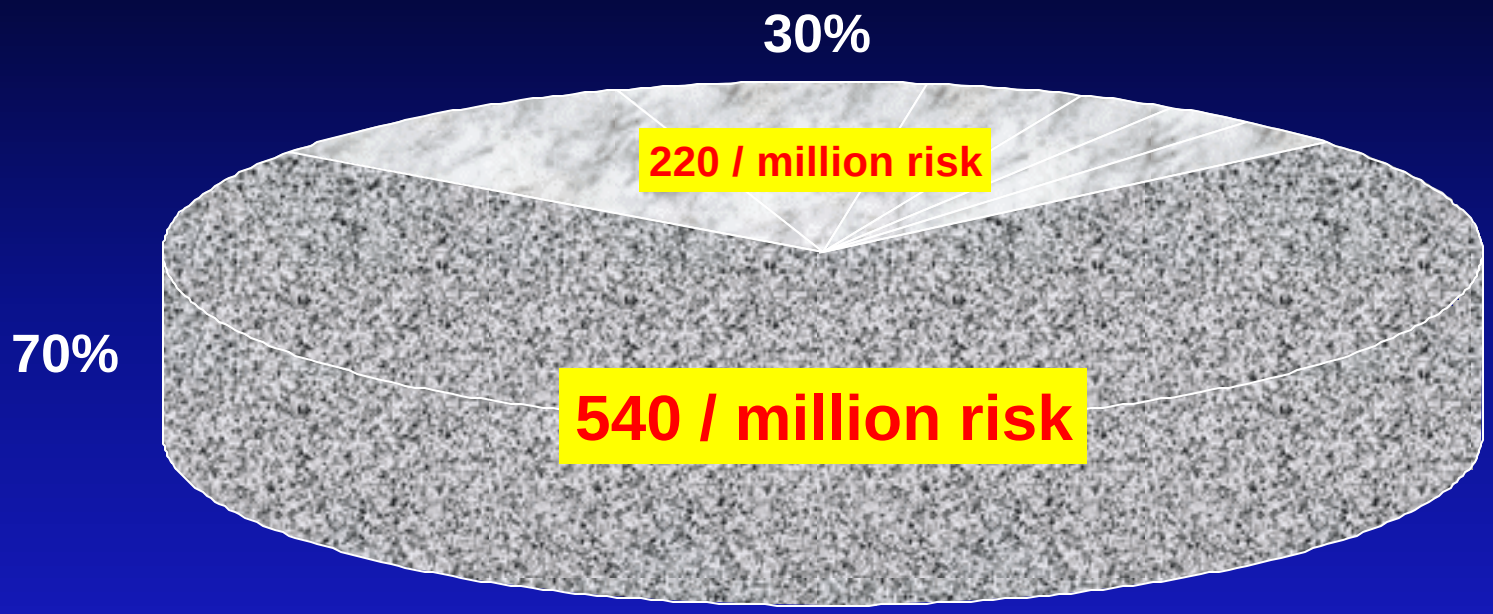
California Environmental Protection Agency
Air Resources Board

Outline

- Background
- Proposed Regulations
- Benefits and Costs
- Remaining Issues
- Conclusions

The Importance of Off-Road Diesels

70% of Air Toxic Risk is From Diesels



Other Air Toxics (30%)

1,3 Butadiene (10%)

Benzene(8%)

Carbon Tetrachloride (4%)

Formaldehyde (3%)

Hexavalent Chromium (2%)

All Others (3%)

Diesel PM (70%)

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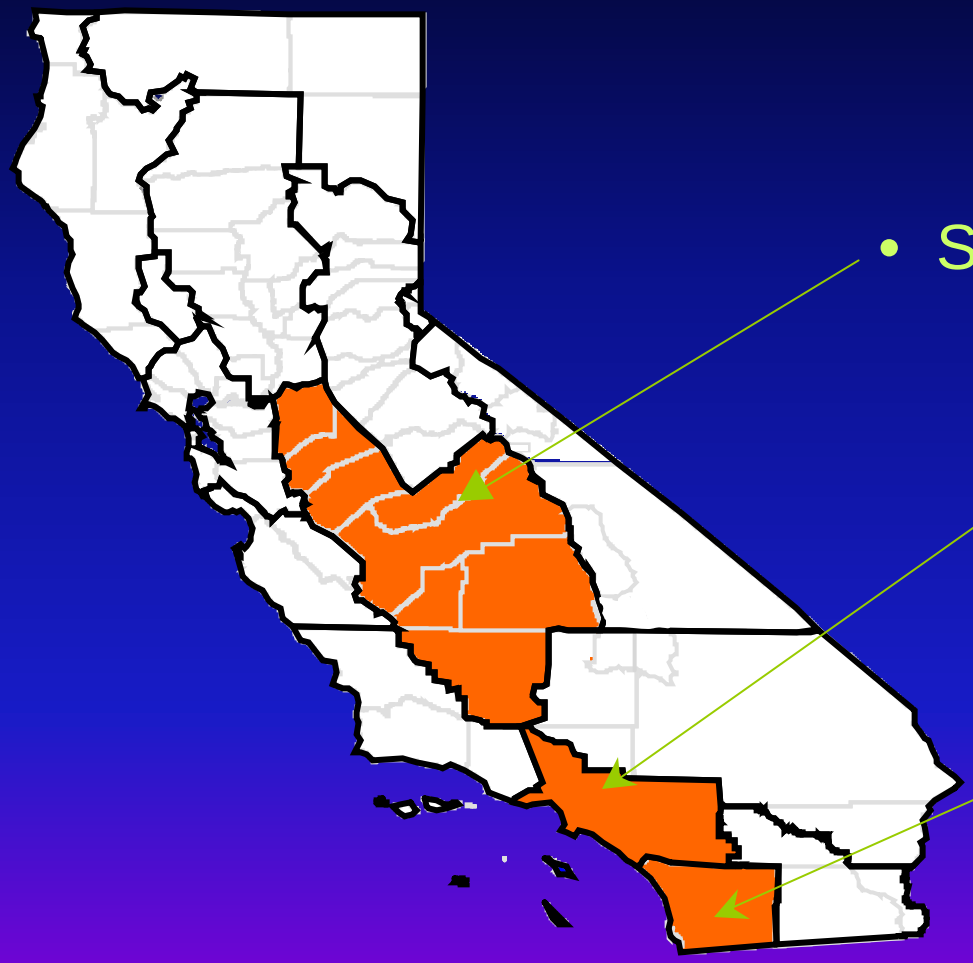
Diesel Related Health Impacts

- Statewide annual statistics
  - 2,900 premature deaths
  - 3,600 hospital admissions
  - 240,000 asthma attacks/respiratory
  - 600,000 lost person-days of work
- By comparison
  - 3,700 deaths from car accidents
  - 2,000 homicides

Federal PM2.5 Nonattainment Areas



- San Joaquin Valley
- South Coast
- San Diego

Nonattainment

Attainment

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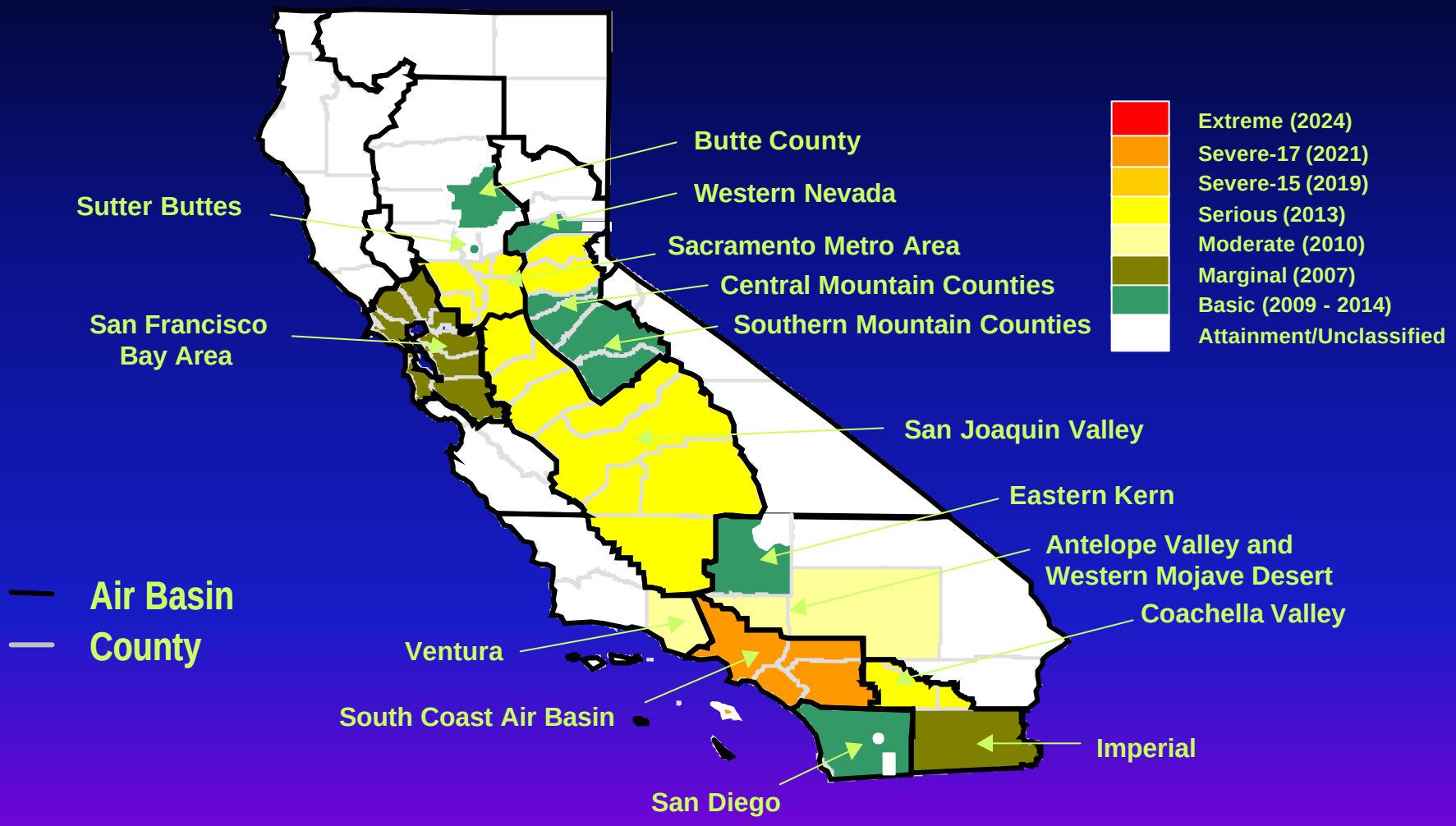
8-Hour Ozone Nonattainment Areas



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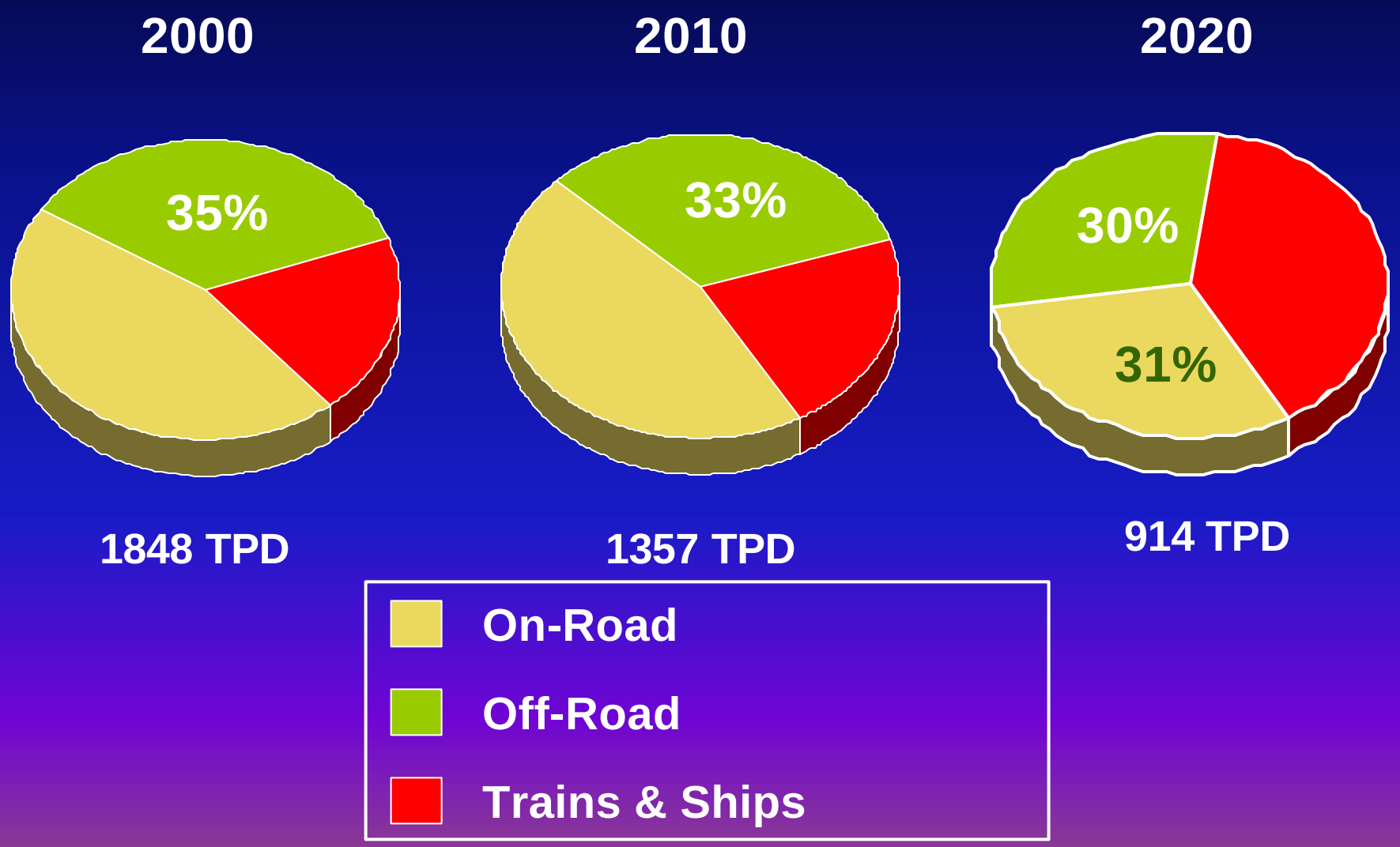
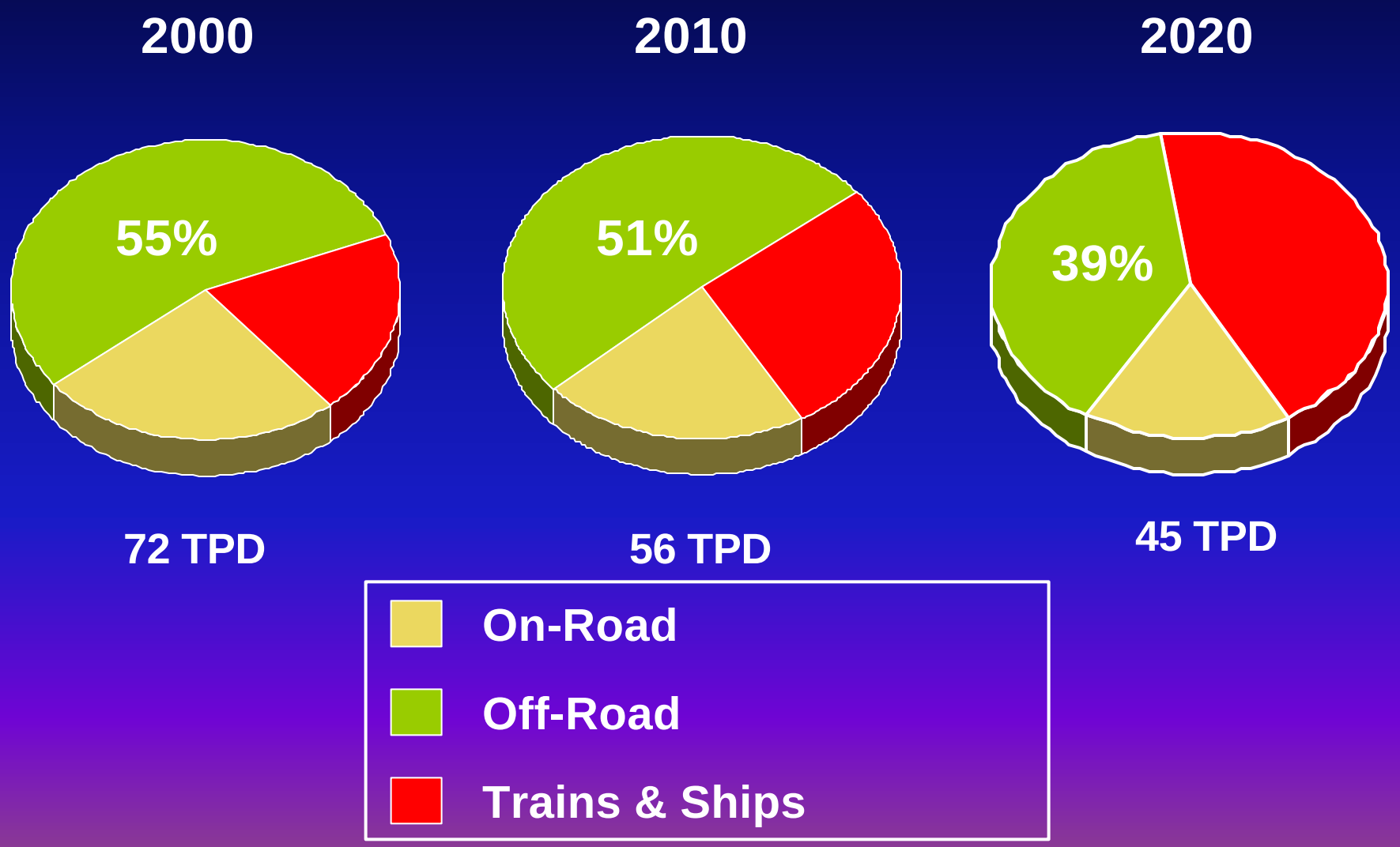
Off-Road is a Significant Contributor to the Mobile Diesel HC+NOx Inventory

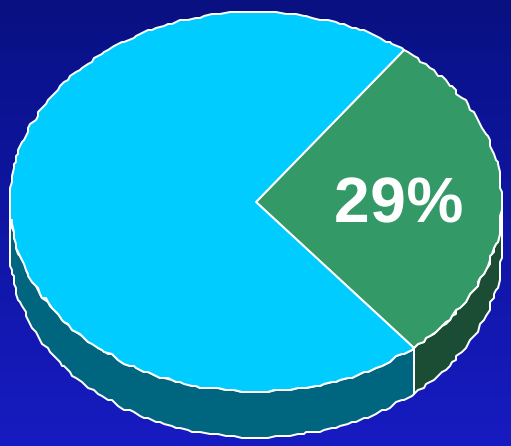


Off-Road is a Significant Contributor to the Mobile Diesel PM Inventory



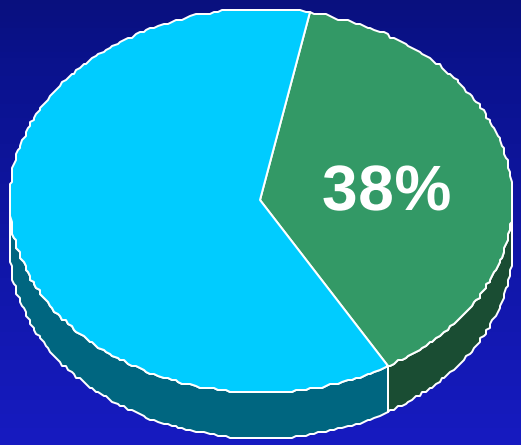
Most of the Off-Road Diesel Emissions Contribution is Preempt (2010)

ROG



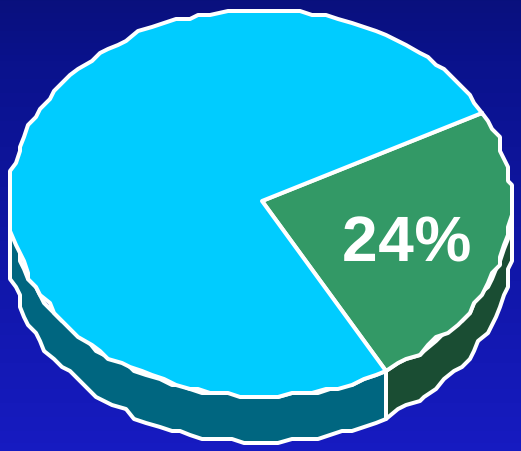
47 TPD

NOx



409 TPD

PM10



29 TPD

- **Federally Preempt Engines**
- **California Non-Preempt Engines**

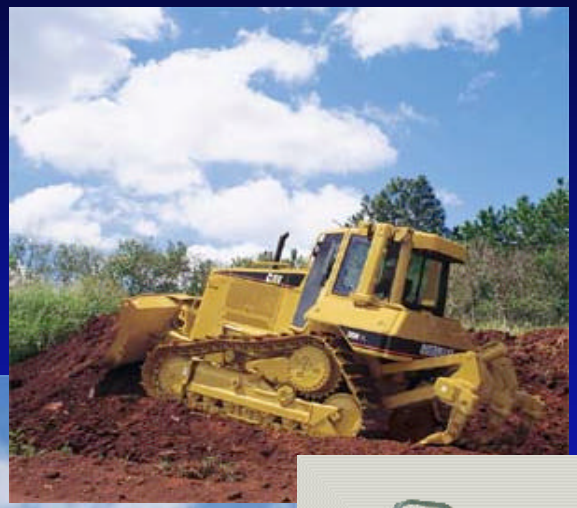
Proposed Tier 4 Regulation

- Alignment with 2004 Federal Nonroad Rule
- 90% PM Reductions
  - Particulate Filters
- 85% NOx Reductions
  - Adsorbers, SCR
- Transient Test Cycle

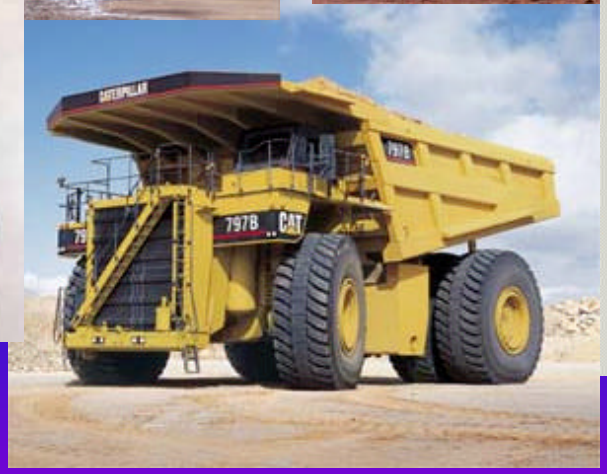
Off-Road Equipment and Power

130 £ kW £ 560

56 £ kW < 130



< 19 kW



> 560 kW

19 £ kW < 56

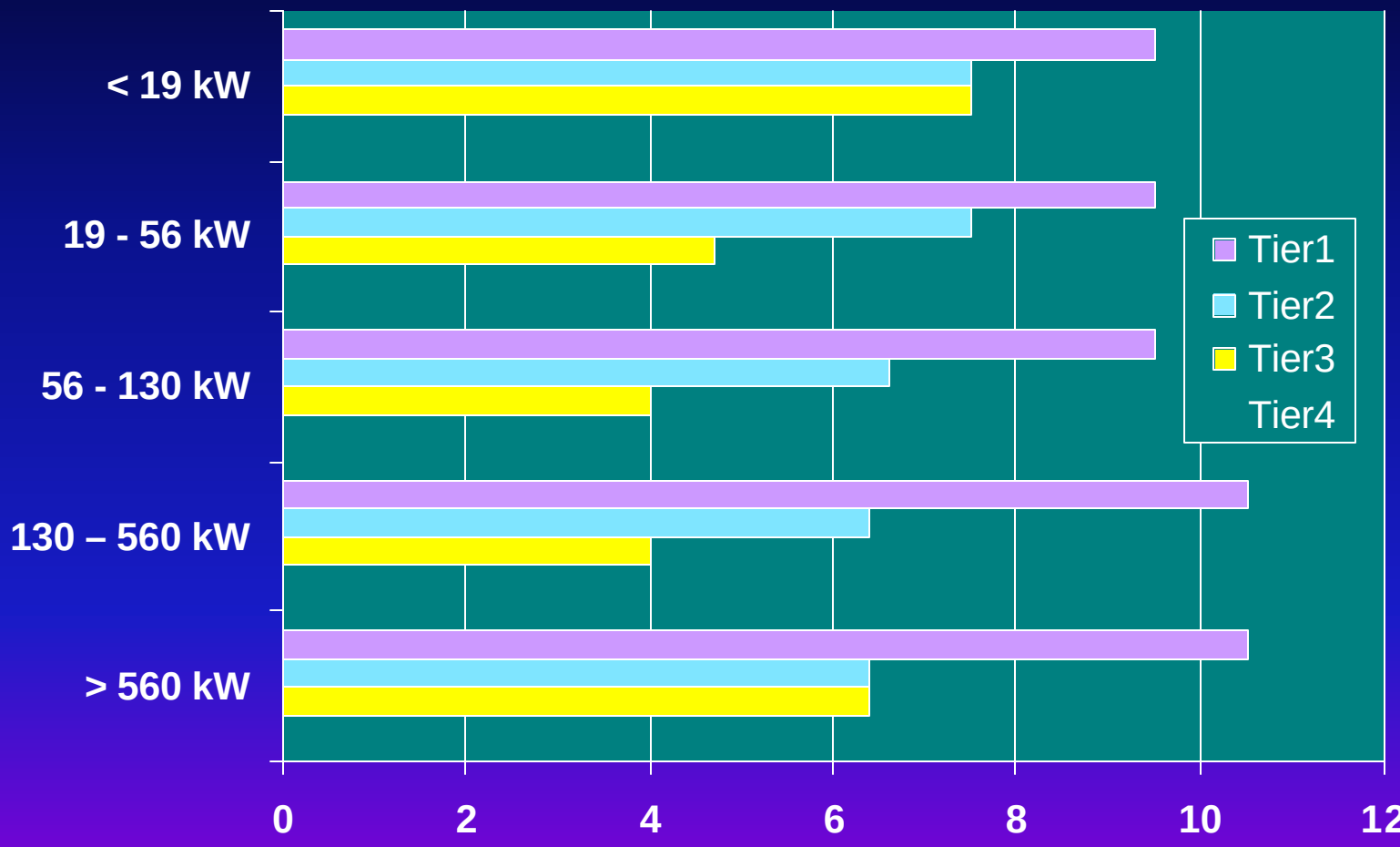
Tier 4 Standards and Schedules

(grams per kilowatt-hour)

POWER CATEGORY	MODEL YEARS	PM	HC+NOx	NOx	NMHC
< 19 kW	2008	0.4	7.5		
19 ≤ kW < 56	2008	0.3	7.5 / 4.7		
	2013	0.03	4.7		
56 ≤ kW < 130	2012	0.02		3.4	0.19
	2015			0.4	
130 ≤ kW ≤ 560	2011	0.02		2.0	0.19
	2014			0.4	
> 560 kW	2011	0.1		0.67 / 3.5	0.4
	2015	0.03 / 0.04		0.67	0.19

HC+NOx Standards Comparison

(grams per kilowatt-hour)



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HC+NOx Standards Comparison

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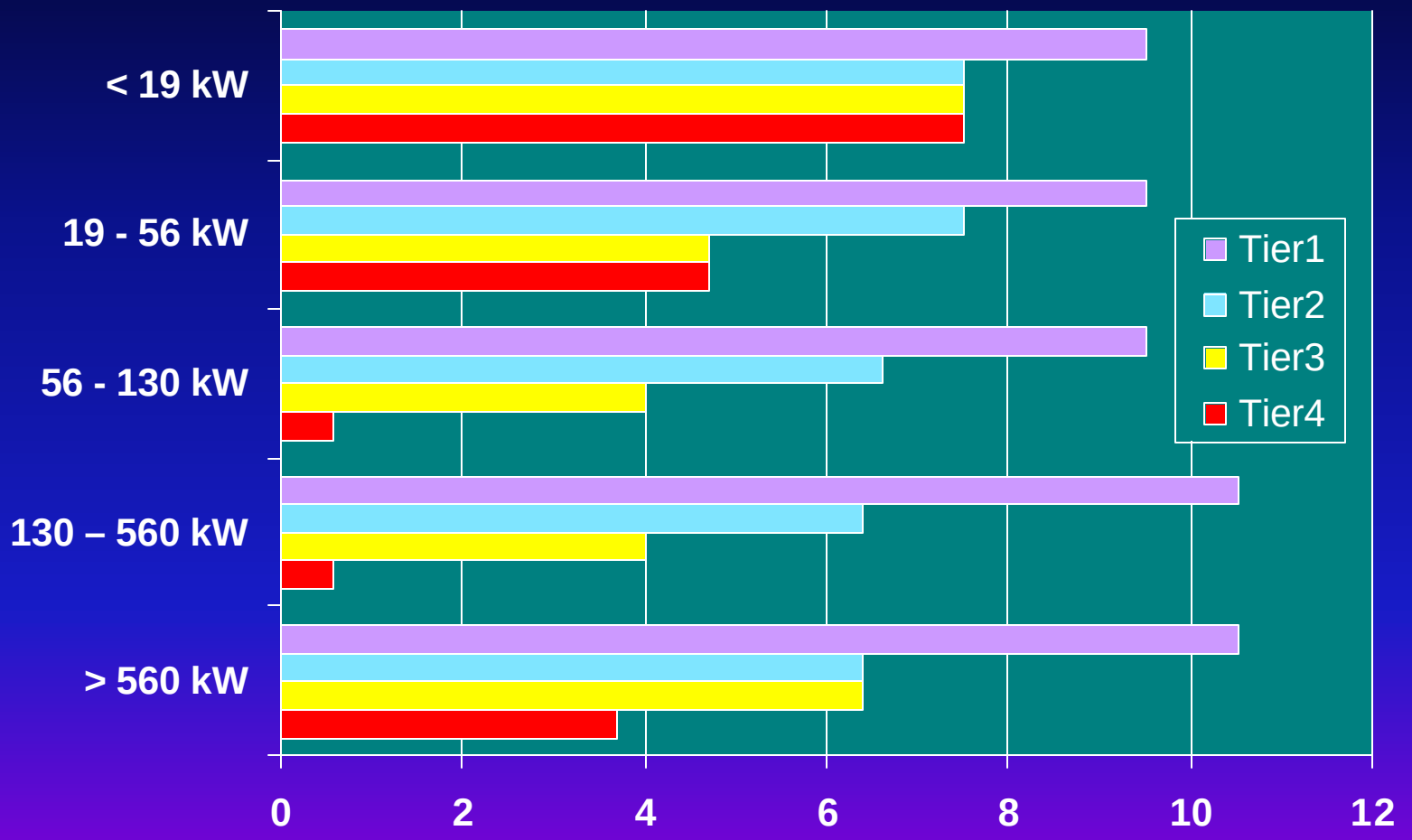

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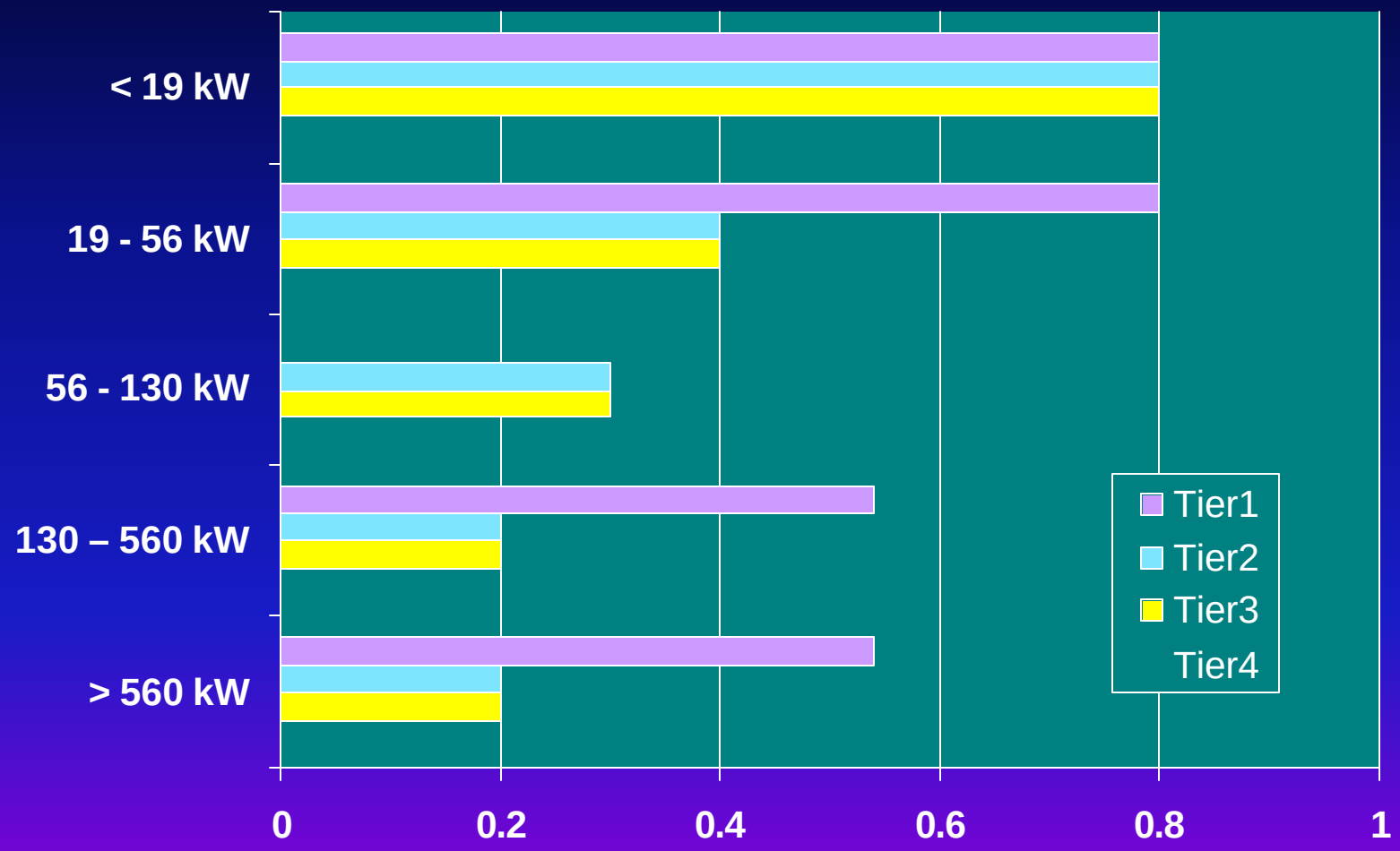
PM Standards Comparison

(grams per kilowatt-hour)



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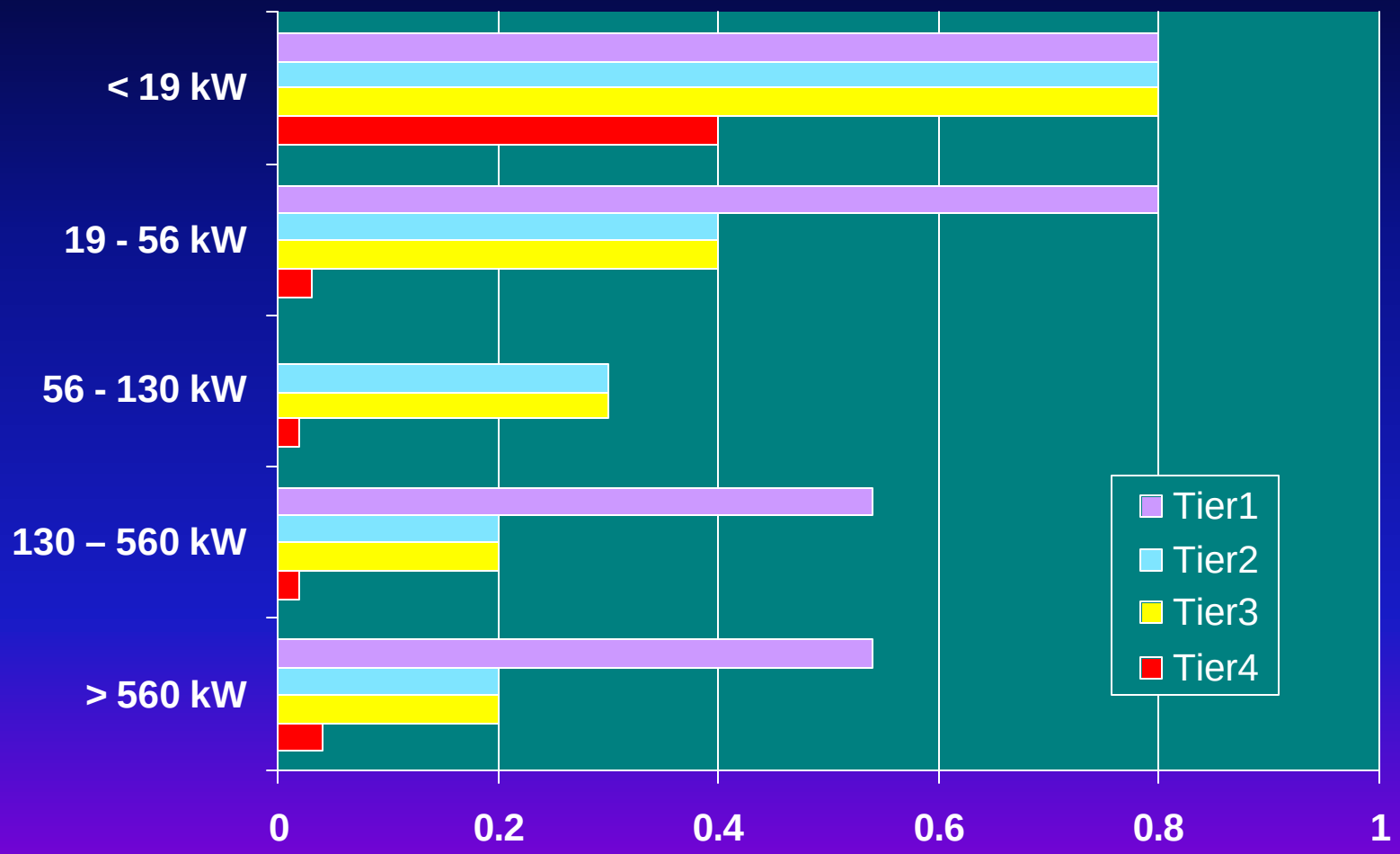

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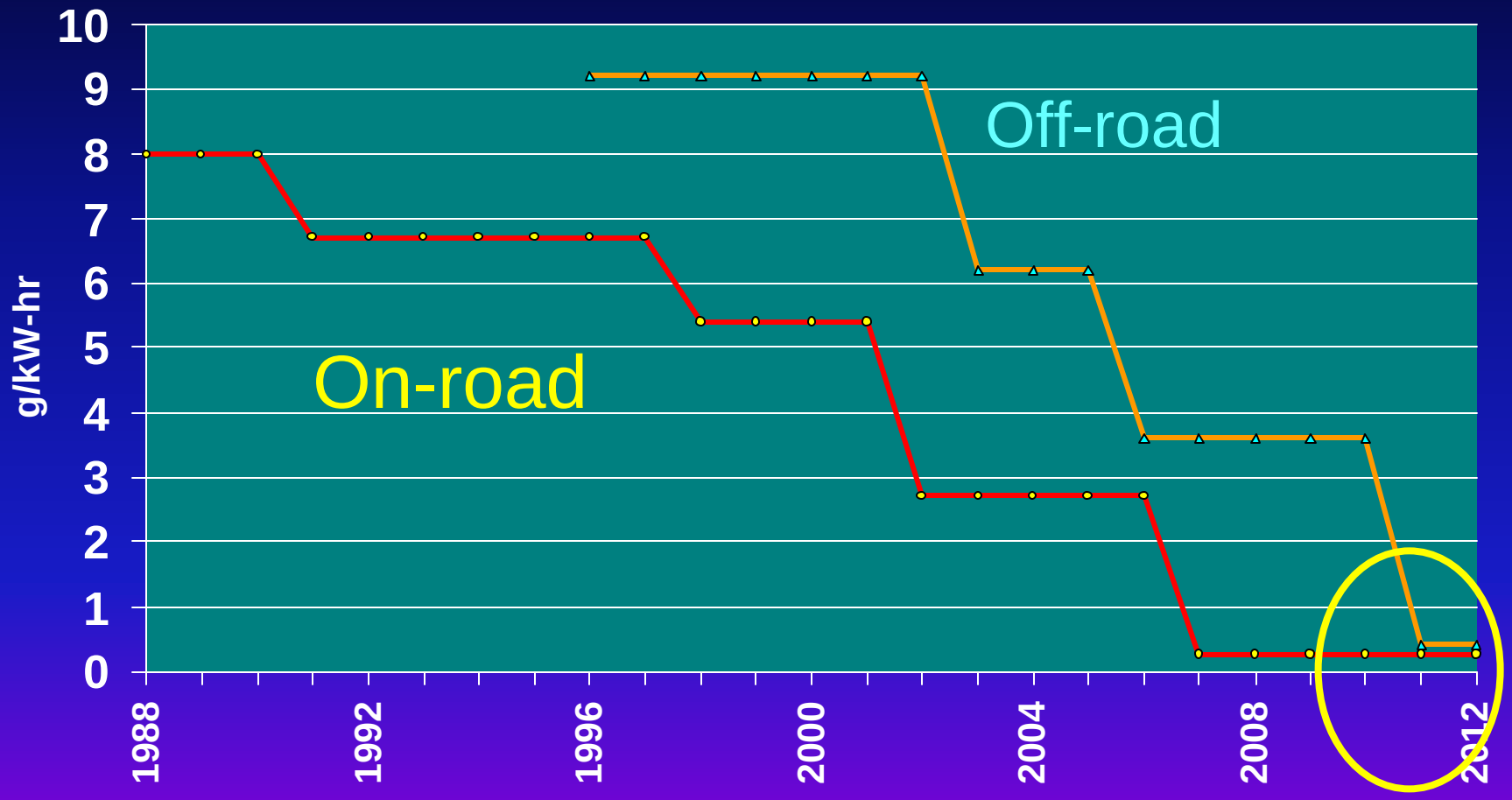
Advanced Control Technologies

- Catalyzed Particulate Filters
- Oxides of Nitrogen (NOx) Aftertreatment
- Ultra Low-Sulfur Diesel Fuel (15 PPM)

Off-Road vs. On-Road NOx Standards

200 kW Engine



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Off-Road vs. On-Road PM Standards

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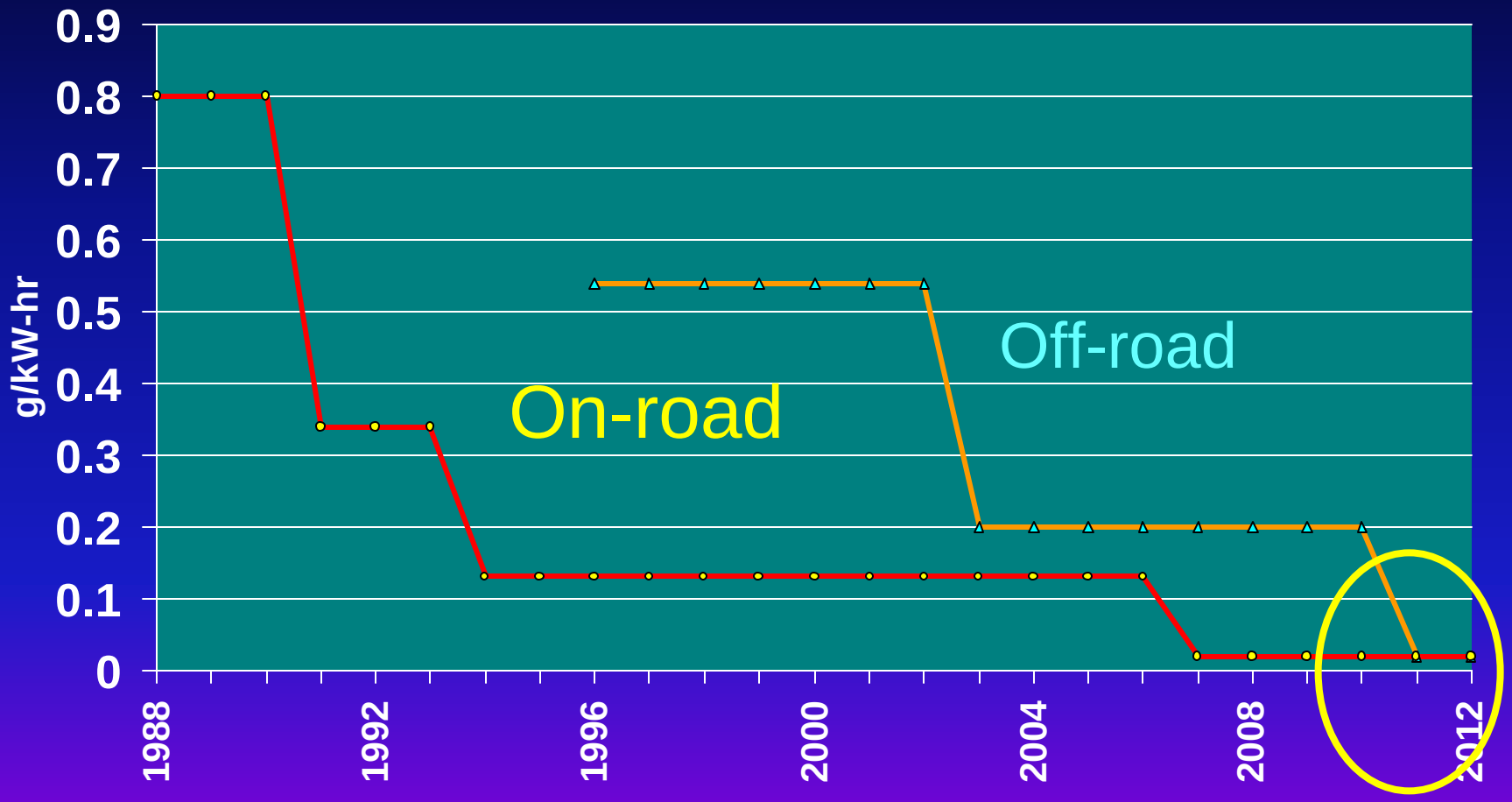

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Tier 4 Implementation Options

- Provides Multiple Compliance Alternatives
  - Phase-in Schedule
  - Alternate NOx Schedule
  - Small Engine Provisions
- Helps to Keep Costs Down

Compliance Options

- Averaging, Banking, and Trading Program
- Equipment Manufacturer Flexibility Program
- Technical Hardship Relief
- Small Business Relief

Tier 4 In-Use Provisions

- Not-To-Exceed Limits
- Revised Defect Reporting
- In-use Margins
- Continued In-use Compliance

Early Introduction Incentives

- Additional Flexibility Allowances for OEMs
  - 2 early earns 1 deferred for Interim NOx
  - 1 early earns 1 deferred for Final NOx
- Engine Offsets for Engine Manufacturers
  - 2 early earns 3 deferred for PM and NOx
  - 1 early earns 2 deferred for Ultra Low NOx

Differences Between Staff's Proposal and the Federal Tier 4 Regulation

- Enhanced Labeling Requirements
  - To identify non-conforming engines in-use
- Certification for Flexibility Engines
  - To ensure complete enforcement authority
- Extended Replacement Engine Reporting
  - To prevent possible abuses of the provision

Tier 4 California Benefits

- Environment (2020 Statewide Reductions)

JURISDICTION	PM	NOx	HC
	Tons Per Day		
California	2.5	38.8	1.8
Federal	4.4	34.0	1.2
Total	6.9	72.8	3.0

- Health
  - Prevents 900 premature deaths /yr in 2030
  - Saves $6.3 billion /yr in health related expenses
  - Prevents 20,000 cases /yr of exacerbated asthma
  - Prevents 400,000 person days /yr of restricted activity

Tier 4 California Costs

- Economic Impacts
  - No significant costs to businesses or individuals beyond the costs of the Federal rule
- Cost Effectiveness
  - $ 0.58 per pound of NMHC+NOx reduced
  - $ 7.55 per pound of PM reduced

Proposed 15 Day Changes

- Clarifications
  - Flexibility labeling on engines ≤ 37 kW
  - National sales for flexibility and defect reporting
  - Definition updates
- Changes
  - Option to use a standardized label instead of the original label on remanufactured engines
  - Simplified executive order for flexibility engines
- Incorporate U.S. EPA Technical Amendments
  - 15 Day Process or Separate Rulemaking

Remaining Issue

- Labeling Remanufactured Engines

  "… When an engine is being replaced, the replacement engine must be an engine of (or rebuilt to) a certified configuration that is equivalent, from an emissions standpoint, to the engine being replaced."

Source: CFR, Part 40, Section 89.130

Remaining Issue

- What is Remanufacturing?
  - The original engine is completely replaced
  - The replacement engine may be made from multiple engine components
  - The replacement engine may not be completely reassembled at the time of sale

Remaining Issue

- Remanufactured Engine Labels are Needed:
  - To verify that engines are assembled in certified configurations
  - To verify that the replaced engine is equivalent or better than the existing engine
- Engine manufacturers are concerned about their liability for incomplete engines

Conclusions

- Tier 4 Provides Significant Benefits
  - Environment
  - Health
- The Requirements are Feasible
  - Same technologies as heavy duty on-road
  - Sufficient lead-time
  - Compliance facilitation provisions
- Harmonization is Cost-Effective