



Update on Phase 2 Greenhouse Gas Emission Standards for Medium- and Heavy-Duty Engines and Vehicles, and Related Research Studies

**October 20, 2016
Fresno, California**

Today's Presentation

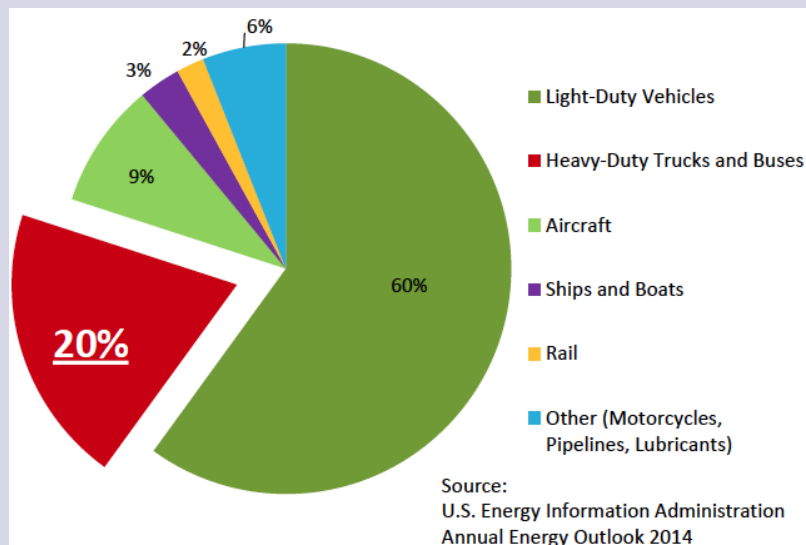
▶ Background

- ▶ Summary of Federal Phase 2 GHG Standards
- ▶ California Phase 2 to Create Nationally Harmonized Program
- ▶ California Heavy-Duty Vehicle Research Updates
- ▶ Next Steps

Medium- and Heavy-Duty Vehicles are a Significant Source of GHG Emissions

▶ Nationwide:

- Medium and Heavy-duty trucks account for 1/5 of transportation sector GHG emissions
- Fastest growing transportation sector in the US and globally



▶ California:

- 21% of Transportation GHG
- 8% of Statewide GHG Emissions

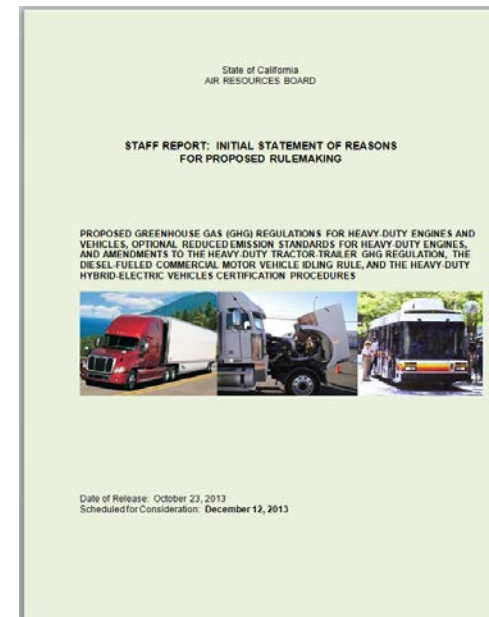


▶ Lower-emitting trucks needed to meet ambitious GHG targets:

- 40% below 1990 levels by 2030
- 80% below by 2050

California Phase 1 GHG Regulations Adopted

- ▶ ARB harmonized with the federal Phase 1 Program in December 2013
- ▶ Gave manufacturers ability to certify in California and ARB ability to enforce
- ▶ Will reduce CO₂ emissions in California by 12% in 2030



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U.S. EPA / NHTSA Phase 2 GHG Standards Adopted

- ▶ Final Rulemaking (FRM) published October 2016 (prepublication version released 8/16/16)
- ▶ Technology forcing
- ▶ Reduce fuel consumption by 82 billion gallons
- ▶ Lower GHG emissions by 1,100 MMT nationally
- ▶ Save vehicle owners \$170 billion in fuel costs
- ▶ Tractor-trailer fuel economy expected to increase from ~6 mpg to ~9 mpg



Phase 2 Engine Standards

- ▶ Up to 5% reduction in GHG emissions from Phase 1 for combination tractor engines
- ▶ Up to 4% reduction in GHG emissions from Phase 1 for vocational engines



Phase 2 Vehicle Standards

Combination Tractors



25% reduction

NEW!

Trailers Pulled by Combination Tractors



9% reduction

Vocational Vehicles



24% reduction

Large Pickups and Vans



16% reduction

Implementation: 2018-2027 for trailers
2021-2027 for all other segments 8

Phase 2 Projected Vehicle Costs and Payback for 2027 MY Standards

	Phase 2 Projected Average Cost Increase per Vehicle	Payback in Years
Tractors	~\$12,300	2
Trailers	~\$1,085	
Vocational Vehicles	~\$2,680	4
Pick-ups/Vans	~\$1,350	3

Phase 2 Final Rule Achieves greater GHG Emission Reductions than Proposed Rule

- Changes to Notice of Proposed Rulemaking (NPRM) based on comments from stakeholders, including CARB, and newest data
- Nationally, Final Rulemaking (FRM) achieves 10% more GHG emission reductions than earlier alternatives considered

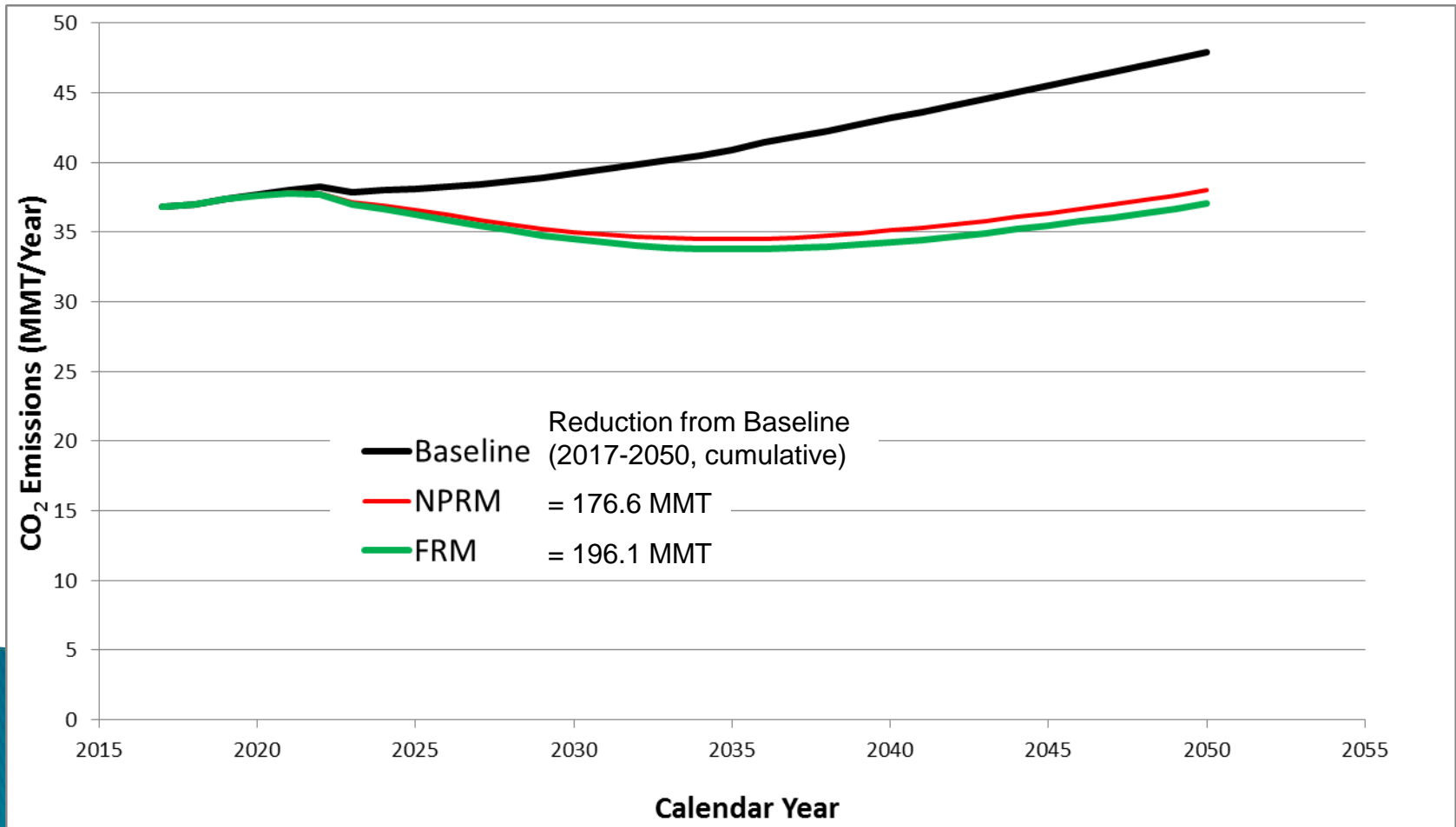


Phase 2 FRM Addressed Majority of ARB's Concerns

- ▶ Tractor engine standards made more stringent
- ▶ Combination tractor, vocational vehicle, and trailer standards made more stringent
- ▶ Particulate matter emissions from diesel-powered auxiliary power units (APUs) controlled
- ▶ Aggressive advanced technology credit multipliers included that provide incentive for zero emission technologies
- ▶ Plans for low NOx standard discussed in preamble



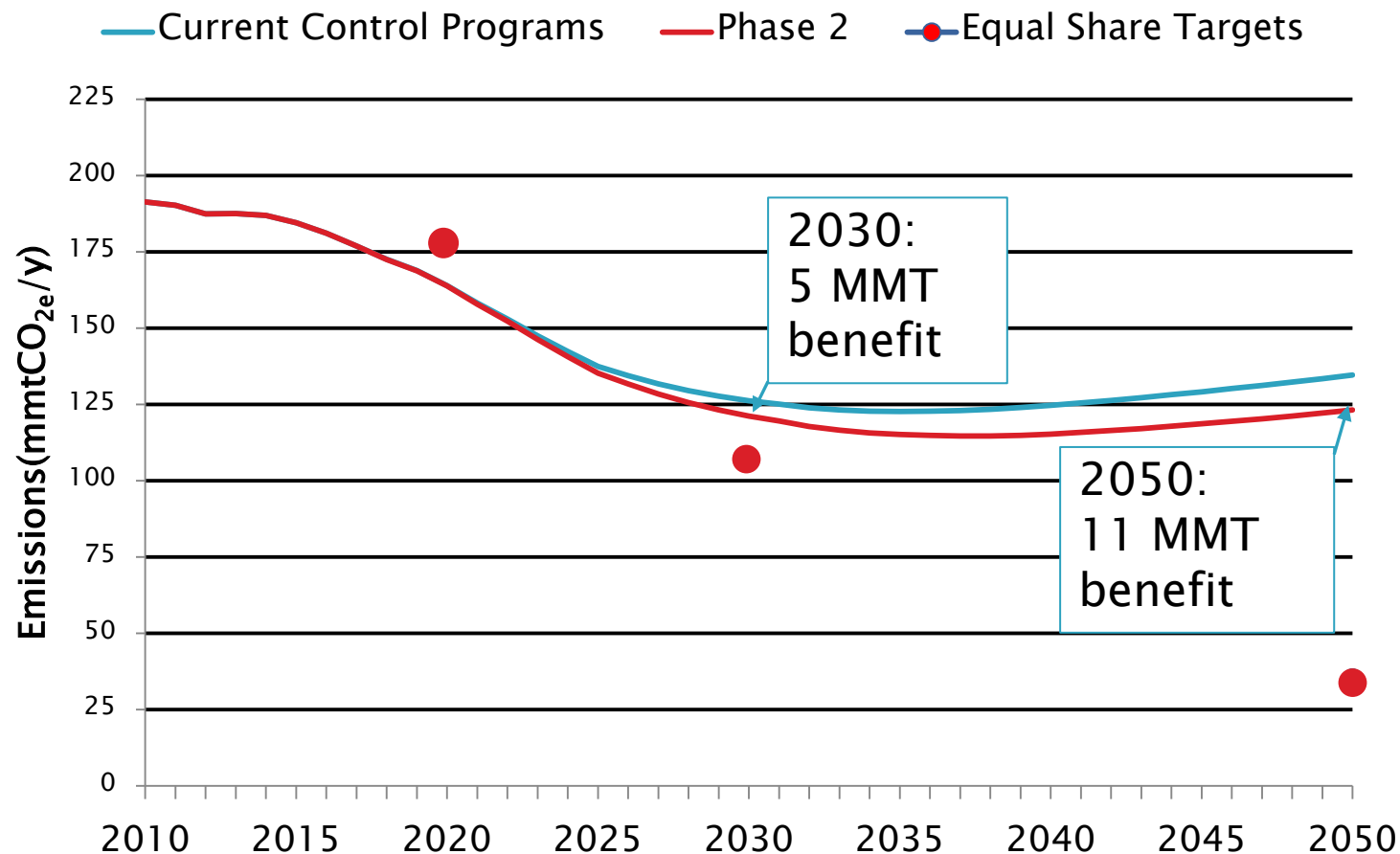
Projected California GHG Benefits from FRM greater than NPRM



Source: ARB EMFAC 2014

Phase 2 Will Get Us Closer To Our Goals

Well-to-Wheel Emissions from California On-Road Sources



Source: ARB (AQPSD) 2016

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California Phase 2: Expect to Propose Harmonization with the National Program

- ▶ One national strategy
- ▶ Harmonize with U.S. EPA's Phase 2 standards
 - Same structure, timing, and stringency levels
 - Critical/key element of scoping plan
 - Would allow ARB to certify engines/vehicles and enforce Phase 2 in California
- ▶ Some modifications to credit, labeling, and rule flexibility provisions
- ▶ Concurrently, amend of TT GHG Rule to remove redundant requirements on trailers



Areas Where California Phase 2 May Differ from Federal Program – Possible Differences

- ▶ Flexibility provisions
 - Optional transition flexibility provisions for meeting the heavy- and medium- heavy duty engine standard
 - Vocational custom chassis
- ▶ Improvements to vehicle and trailer labeling
- ▶ Minor differences in how natural gas engines are treated
- ▶ Encourage use of low-global warming potential refrigerants
- ▶ Minor differences in credits
- ▶ Other minor differences



Possible Future California Fleet Regulatory Development: TT GHG 2 Rule

- ▶ Description
 - Develop aerodynamic requirements for non-box trailer types that travel significant time at high speeds
- ▶ Timeline
 - Complete trailer activity study: 2017
 - Workshops: October 2017, March 2018
 - ARB rulemaking process: 2018-2019



Possible Future California Fleet Regulatory Development: Vocational Vehicle Aerodynamics

► Description

- Develop aerodynamic requirements for the vocational vehicles that travel most at high speeds

► Timeline

- Workshop Schedule: November 2017, April 2018
- ARB rulemaking process: 2018-2019



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Vocational Truck Studies

- ▶ Vocational Aerodynamics (U.S. Department of Energy's National Renewable Energy Laboratory (NREL)):
 - Cost: \$390,000
 - Tested box trucks with and without aerodynamic devices
 - GHG emission benefits up to 8% depending on duty cycle
 - Draft report completed March 2016
- ▶ Follow-up Study (NREL and UC Irvine):
 - Characterize vocational truck fleets and driving patterns for Class 4-6 trucks in California
 - Cost: \$400,000
 - Scheduled completion date: 2018



Collection of Tractor-Trailer Activity Data

- ▶ ARB contracted with University of California Riverside Center for Environmental Research and Technology, College of Engineering (UCR)
- ▶ Cost: \$489,000
- ▶ UCR gathering activity and engine data from non-box type tractor-trailers (e.g., tankers, flatbeds)
- ▶ Determine whether additional trailer types will benefit from using aerodynamic devices
- ▶ Scheduled completion date: June 2017



Additional Research Studies

- ▶ Collection of Activity Data from On-Road Heavy-Duty Diesel Vehicles (UCR)
 - Cost: \$324,000; Scheduled completion date: December 2016
- ▶ In-Use Emissions Testing and Fuel Usage Profile of On-Road Heavy-Duty Vehicles (UCR and WVU)
 - Co-funded by SCAQMD, CEC, SoCal Gas, and ARB
 - ARB Cost: \$150,000 of \$3,000,000;
Scheduled completion date: December 2018
- ▶ Identify Pathways to Near Zero Heavy-Duty Sector (not yet awarded)
 - Cost: \$500,000; Scheduled completion date : December 2019
- ▶ In-House Vehicle Speed Limiter Study (ARB)
 - Scheduled completion date: Spring 2017



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Next Steps

- ▶ February 2017: Workshop on California Phase 2
- ▶ October 2017: Board consideration of California Phase 2 proposal
- ▶ Potential rulemakings for vocational aerodynamics and TT GHG 2 planned for Board consideration in 2019
- ▶ ARB staff will begin to monitor technology and conduct research for potential Phase 3 GHG planning
- ▶ ARB staff also focusing on NOx control
 - First low-NOx workshop scheduled for November 3, 2016

EXTRA SLIDES

FRM Tractor Engine, Tractor, Trailer, and Vocational Vehicle Standards More Stringent than NPRM

- ▶ Emission standards versus baseline standards

	FRM 2027 GHG/Fuel Consumption Reductions (per new vehicle)	NPRM 2027 GHG/Fuel Consumption Reductions (per new vehicle)
Separate Engine Standards	5% Tractor 4% Vocational	4% Tractor 4% Vocational
Combination Tractors (including Engine Improvements)	25%	24%
Trailers	9%	8%
Vocational Vehicles (including Engine Improvements)	24%	16%
Pickups and Vans	16%	16%

Proposed California Phase 2 Carbon Dioxide (CO2) Benefits

CO2 Emissions from Affected Vehicles (in million metric tons per year)			
Calendar Year	Baseline CO2 Emissions	CO2 Emissions with Phase 2	CO2 Reductions
2030	39.2	34.5	12%
2050	47.9	37.0	23%

PM Emissions from APUs Regulated in FRM

- ▶ FRM requires diesel APUs to meet diesel PM emission standards
 - Model Year 2018 through 2023 must meet 0.15 g (PM)/kW-hr standard
 - Model Year 2023+ must meet 0.02 g(PM)/kW-hr standard

Plans to Develop Low NOx Standards Included in Preamble

- ▶ Section I.F.(1), “Opportunities for Further Oxides of Nitrogen (NOx) Reductions from Heavy-Duty On-Highway Engines and Vehicles”
 - “EPA believes the opportunity exists to develop, in close coordination with CARB and other stakeholders, a new, harmonized national NOX reduction strategy for heavy-duty on-highway engines which could include the following:
 - Substantially lower NOX emission standards;
 - Improvements to emissions warranties;
 - Consideration of longer useful life, reflecting actual in-use activity;
 - Consideration of rebuilding/remanufacturing practices;
 - Updated certification and in-use testing protocols;
 - Incentives to encourage the transition to next-generation cleaner technologies as soon as possible;
 - Improvements to test procedures and test cycles to ensure emission reductions occur in the real-world, not only over the applicable certification test cycles”

Engine Standards Made More Stringent in FRM

- ▶ Vehicle standards based on use of engines cleaner than standard

Diesel Engines	NPRM Engine Standard CO2 g/bhp-hr (% reduction from NPRM baseline)	FRM Engine Standard CO2 g/bhp-hr (% reduction from FRM baseline)	Estimated FRM Engine emission rate used to establish vehicle standard
HHD Tractor	441 (-4.1%)	432 (-5.1%)	426 (sleeper cab) (-6.4%) 428 (day cab) (-5.4%)
HHD Vocational	533 (-4.0%)	503 (-4.2%)	500 (-4.8%)
MHD Tractor	466 (-4.3%)	457 (-5.0%)	455 (-5.4%)
MHD Vocational	553 (-4.0%)	535 (-4.1%)	531 (-4.8%)
LHD Vocational	553 (-4.0%)	552 (-4.2%)	548 (-4.8%)

ARB's Submitted Extensive Comments on NPRM to Docket

- ▶ October 13, 2015: 176 page comment letter on all aspects of NPRM
- ▶ Additional submittals:
 - December 3, 2014: Solar reflective paint credit
 - December 29, 2014: Excess NO_x emissions from hybrid vehicles
 - August 28, 2015: PM emission increase from diesel Auxiliary Power Unit (APU) use
 - June 16, 2016: Recommendation and basis for Advanced Technology Multipliers