

# ***DoE SuperTruck Program***

***Technology and System Level Demonstration of Highly  
Efficient and Clean, Diesel Powered Class 8 Trucks***



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Presenter: Scott Newhouse

Peterbilt Motors Company

Project ID: ARRAVT081

17 May 2012

# **Relevance - Program Objectives**

## ***(DoE Vehicle Technologies Goals)***

**Objective 1:** Engine system demonstration of 50% or greater BTE in a test cell at an operating condition indicative of a vehicle traveling on a level road at 65 mph.

### **Objective 2**

- a: Tractor-trailer vehicle demonstration of **50% or greater freight efficiency improvement** (freight-ton-miles per gallon) over a defined drive cycle utilizing the engine developed in Objective 1.
- b: Tractor-trailer vehicle demonstration of **68% freight efficiency improvement** (freight-ton-miles per gallon) over a defined 24 hour duty cycle (above drive cycle + extended idle) representative of real world, line haul applications.

**Objective 3:** Technology scoping and demonstration of a 55% BTE engine system. Engine tests, component technologies, and model/analysis will be developed to a sufficient level to validate 55% BTE.

Baseline Vehicle and Engine: 2009 Peterbilt 386 Tractor  
and Cummins 15L ISX Engine

# **Relevance - American Recovery and Reinvestment Act (ARRA) Goals**

- Create and/or Retain Jobs

Year	2010	2011	Projections	
			2012	2013
Full Time Equivalent	75.5	85	70	45

States: Indiana, Texas, Michigan, Wisconsin, Tennessee, Illinois, California

- Spur Economic Activity
  - Greater Than \$40M Total Spend To Date
- Goals Align With VT Multi-year Program Plan 2011-2015
  - Advanced Combustion Engine R&D (ACE R&D):
    - 50% HD Engine Thermal Efficiency By 2015 (Ref: VT MYPP 2.3.1)
  - Vehicle And Systems Simulation And Testing (VSST):
    - Freight Efficiency Improvement of 50% by 2015 (Ref: VT MYPP 1.1)
- Invest In Long Term Economic Growth
  - Commercial Viability Assessment
  - Adopt Technologies into Product Plans to Meet GHG and CO2 Regs <sup>3</sup>

# Overview - Schedule and Budget

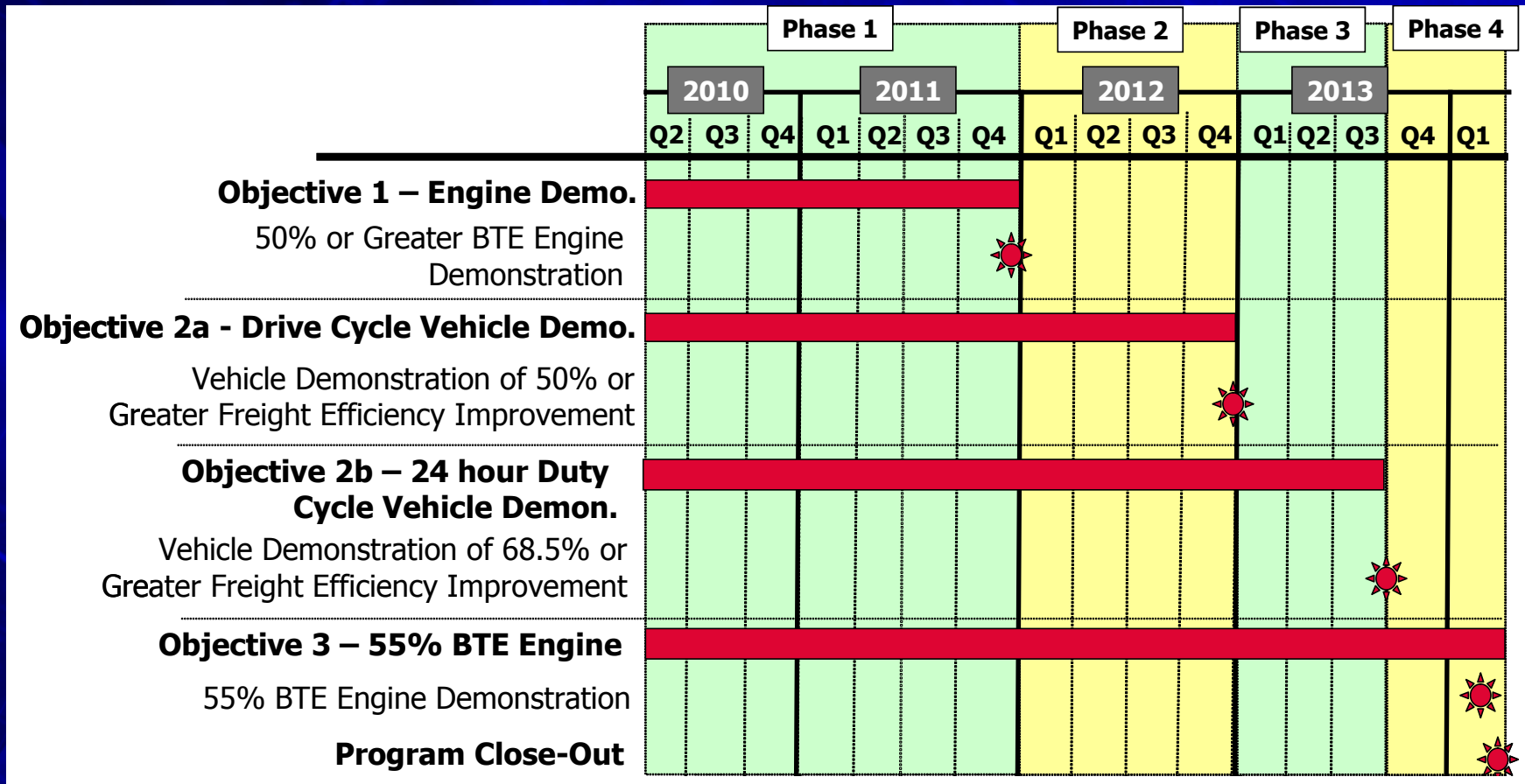
## Budget

DoE Share: \$38.8M (49%)

DOE Spend To-Date: \$20.2M

Contractor Share: \$40.3M (51%)

**4 Year Program: April 2010 to April 2014**



# Peterbilt Participants

- Contract Lead - Cummins 

- Suppliers

- Modine – Cooling Module



- Eaton – Transmissions



- Bendix – Brakes and Suspension



- Dana – Drivetrain



- Bridgestone & Goodyear – Fuel Efficient Tires



- Alcoa - Wheels



- Delphi – Solid Oxide Fuel Cell APU



- Bergstrom – eSHVAC



- Garmin – 3D Map and Display



- Exa – CFD Analysis



- OEM

- Utility Trailer Manufacturing



- End User

- US Xpress



# ***Comprehensive Approach with Enabling Technology***

**Idle Management  
(APU)**

**Enhanced  
Tractor and  
Trailer  
Aerodynamics**

**Transmission/Axle  
Technology**

**Weight  
Reduction**

**Highly Efficient  
Engine/  
Aftertreatment**

**Route  
Performance  
Management**

**Next Generation  
LRR Tires**

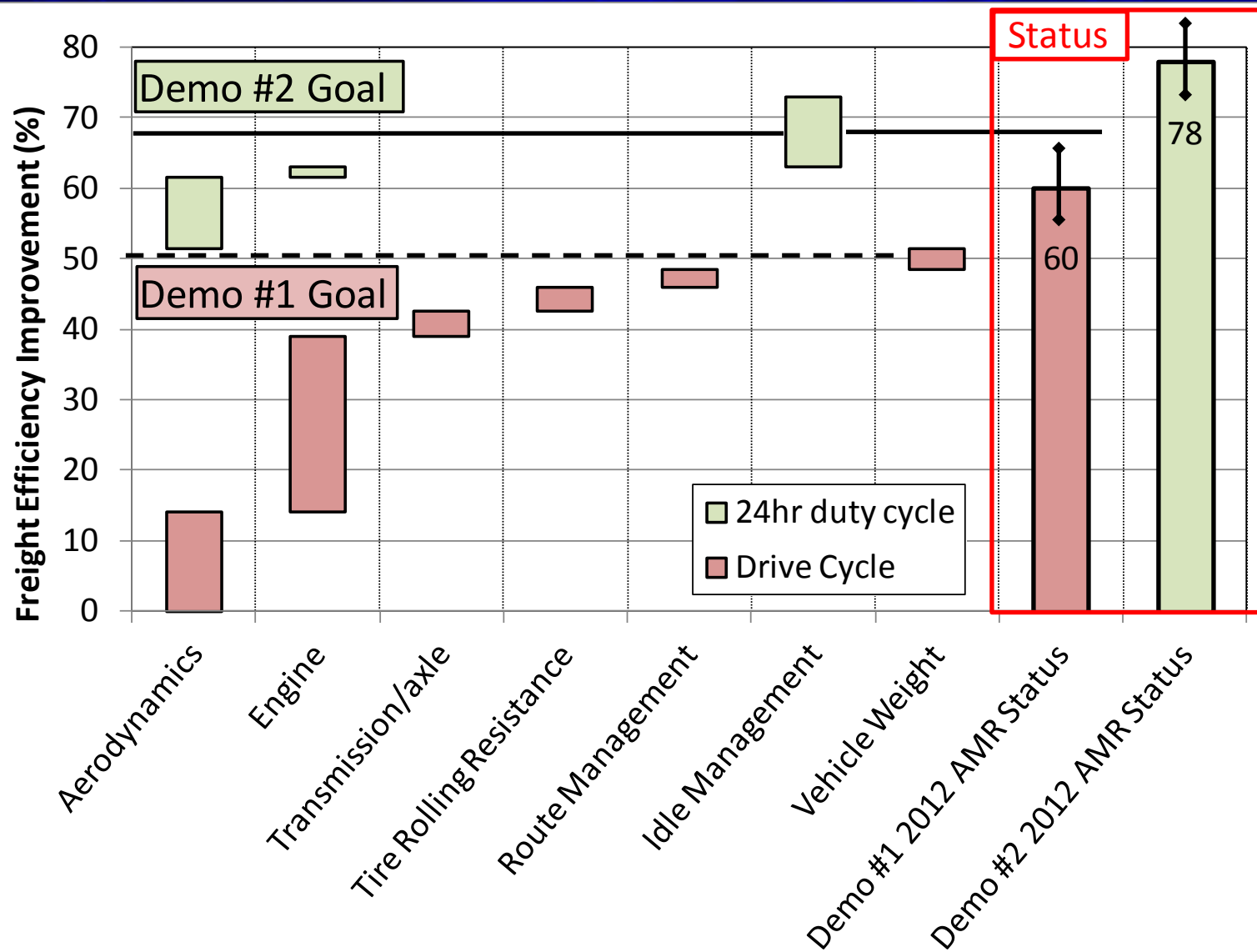
**Driver Display with  
Fuel Economy Tools**



# **Approach** – **Freight Efficiency Path to Target** **Original Plan**

	Drive Cycle Vehicle Demonstration	24 Hour Duty Cycle Vehicle Demonstration
Technology	Freight Efficiency Improvement (%)	Freight Efficiency Improvement (%)
Vehicle Aerodynamics	14%	24%
Engine	25.5%	27%
Transmission/ Axles	3.5%	3.5%
Rolling Resistance	3.5%	3.5%
Route Performance Management	2.5%	2.5%
Idle Management	N/A	10%
Vehicle Weight	3%	3%
Total	52%	73.5%
Target	50%	68.5%

# Approach – Freight Efficiency Path to Target

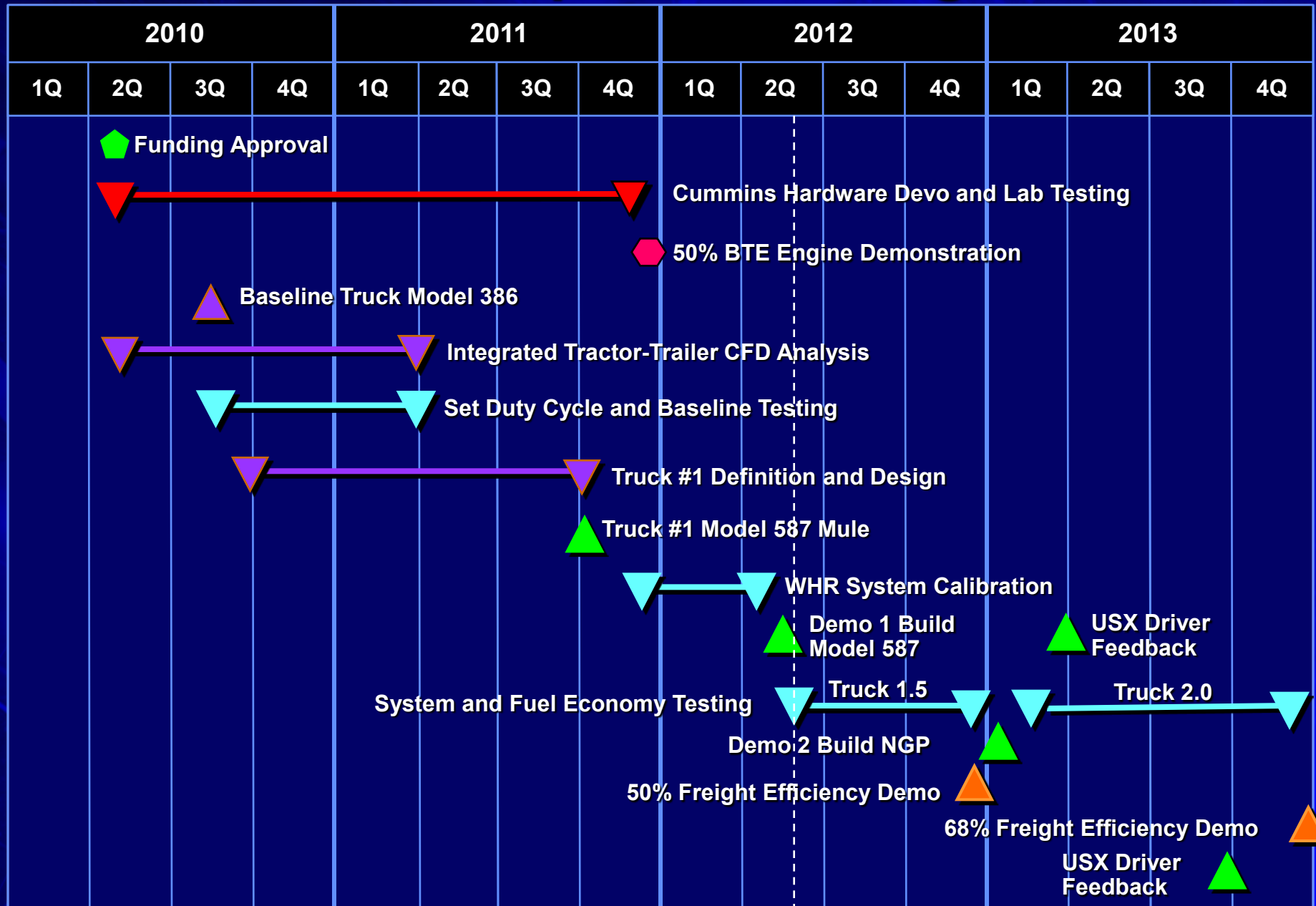


## Overview - Program Barriers

- ✓ • Underhood Cooling with Waste Heat Recovery
- ✓ • Vehicle and Engine System Weight Reduction
- ★ • Engine Downspeak (Reduced Engine Speed)
  - Powertrain Components
  - Vibration/Customer Acceptance
- ★ • Trailer Aerodynamic Devices that Meet Operational Requirements
- ★ • Vehicle and Powertrain Communication Speed

★ = To Be Validated on Demonstrator Truck

# DoE SuperTruck Program

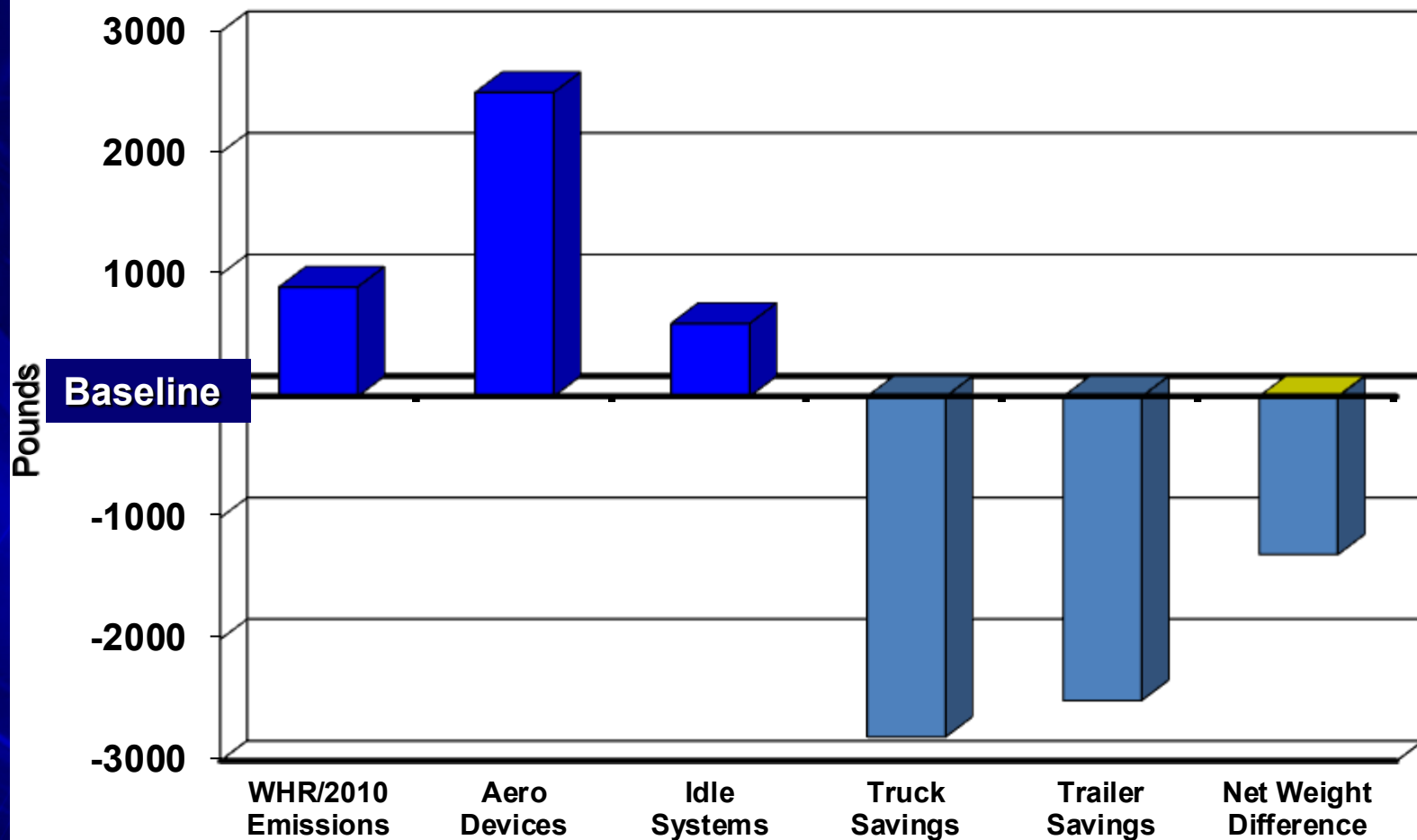


# 587 Engineering Mule – Technical Progress

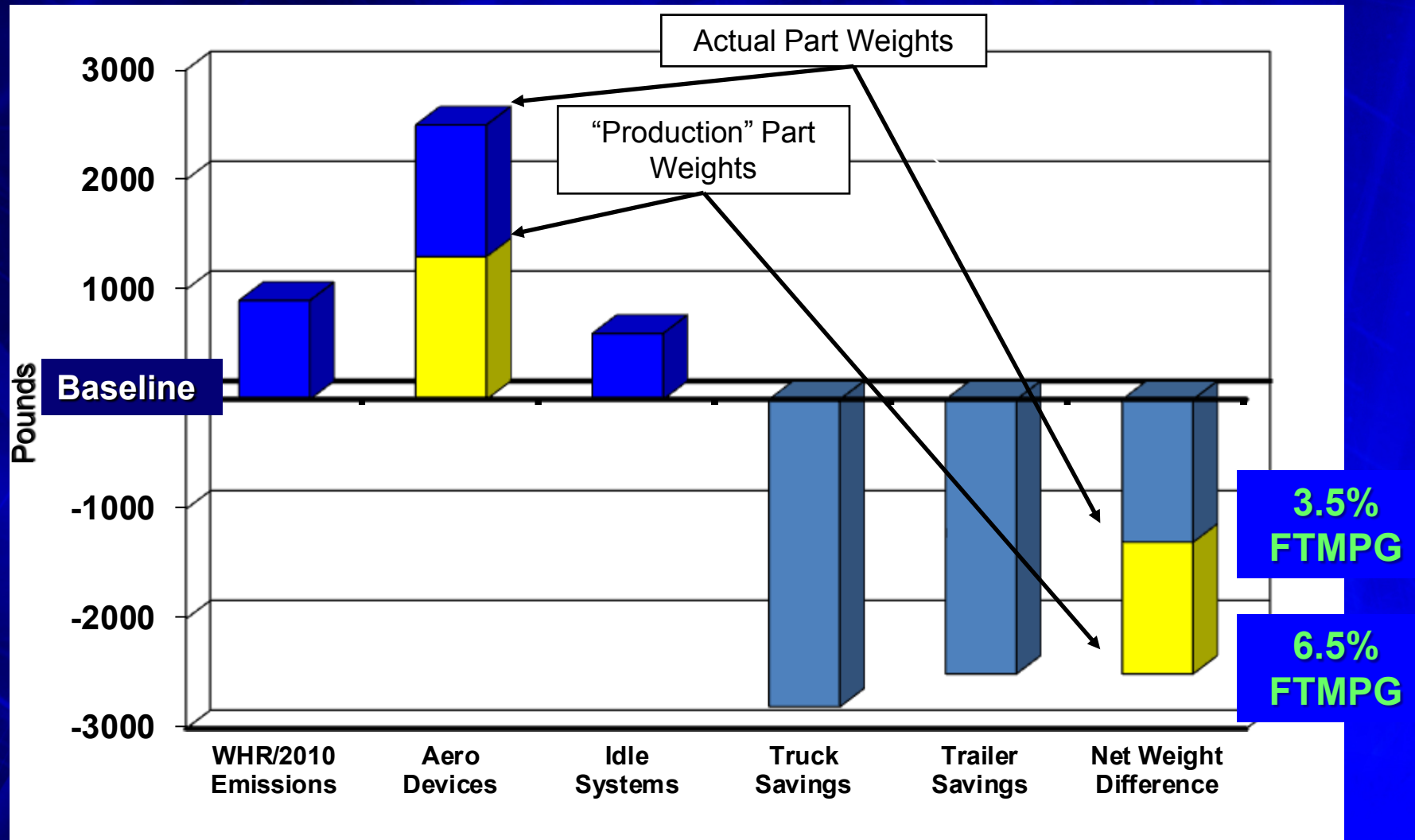


- Successful Packaging of Technologies
- No Increase in Frame Length

# ***Truck/Trailer Weight – Technical Progress***



# Truck/Trailer Weight – Technical Progress

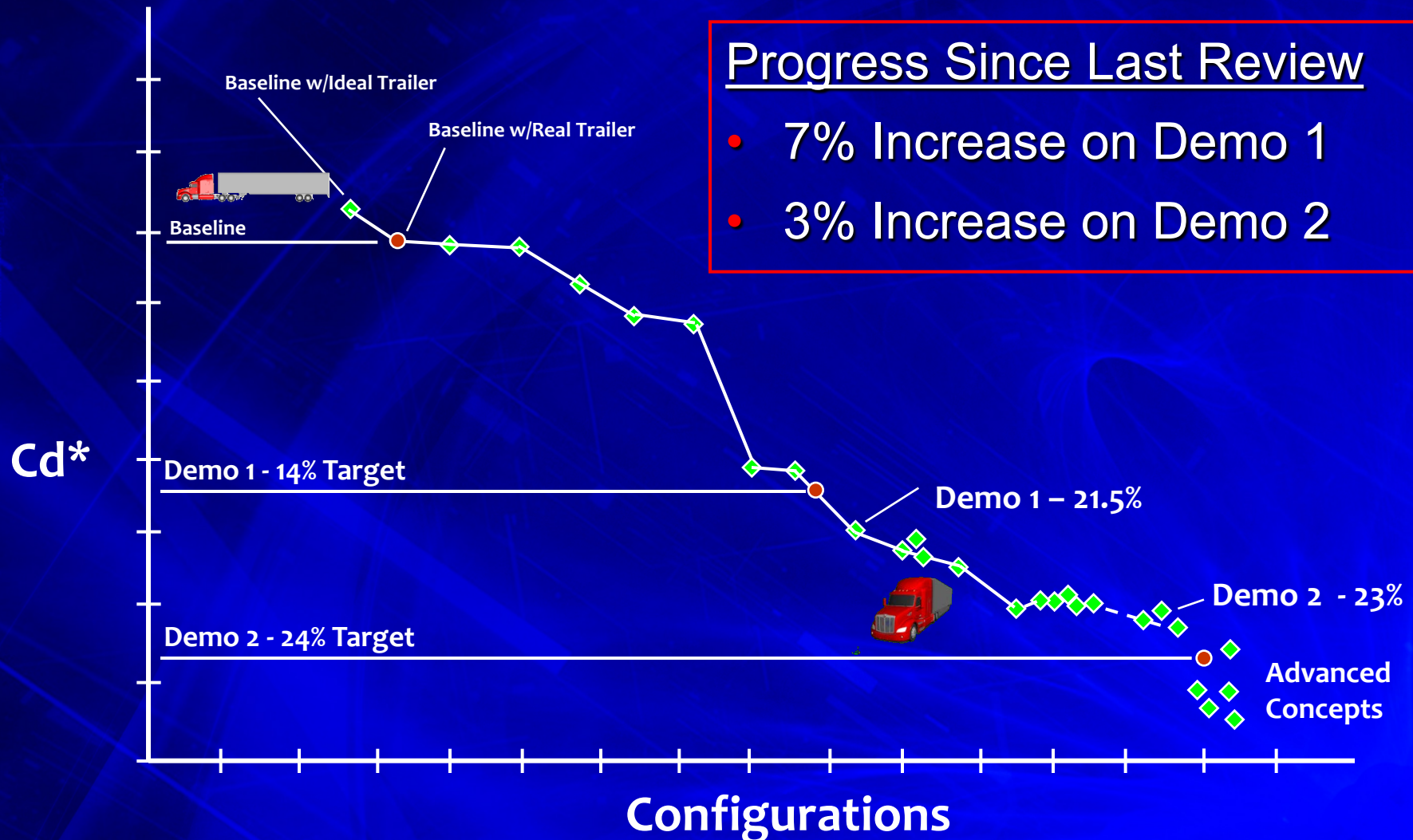


# ***Trailer Development – Technical Progress***



- Trailer Build Complete
- Preliminary Aerodynamic Road Test Complete
- End Customer Input In Process

# Aerodynamic Improvements – Technical Progress



\*  $C_d$ 's Shown Are Adjusted to SAE J1252 Baseline Using  
% Average Deltas From 0 and 6 Degree CFD Runs

# **Aerodynamics - Approach**

SuperTruck/SuperTrailer  
46% Improvement As Shown  
49% With Camera Cab Mirrors

**Equivalent  
Aerodynamics**

Advanced Concept With SuperTrailer  
With Camera Cab Mirrors  
49.6% Improvement

# ***Milestones and Technical Accomplishments***

- March 2011 to March 2012 – **Technical Accomplishments**
  - Path to Target Analysis for Engine and Vehicle Efficiencies
  - Aerodynamic Components Fabricated and Initial Testing
  - Initial Vehicle Tests of Cummins Waste Heat Recovery
  - Initial Testing of Advanced Transmission
  - Performance Assessment of SOFC APU
- March 2012 to March 2013 – **Future Work**
  - Engine Calibration and Optimization Work
  - Vehicle Testing of Advanced Transmission
  - Testing of Tractor – Trailer Aerodynamics Solution
  - Build and Test Vehicle Demonstration 1 (Objective 2a)
  - Design Freeze Vehicle Demonstration 2 (Objective 2b)
  - Initial Calibration of Second Generation of SOFC APU

# Summary

- Program Remains On Schedule
  - Meeting the ARRA and DoE VT MYPP goals
- Roadmaps Updated for Freight Efficiency and 50% Engine Efficiency
- Vehicle Packaging and Integration Proceeding Without Major Issues
- Build and Test of Sub-Systems Are On The Planned Cummins Waste Heat Recovery Vehicle Test (Objective 2a)
- Advanced Transmission Dynamometer and Vehicle Test (Objective 2a)
- Solid Oxide Fuel Cell 2nd Design Iteration Lab Tests (Objective 2b)