California Activities Relative to Heavy-Duty Vehicle Fuel Economy

ICCT Workshop, February 22, 2006

San Diego, CA

Advanced Transportation Technologies

Clean Transportation Solutions SM

John Boesel

President & CEO

Presentation Overview

- CA Specific Policy Drivers
- HDV Petroleum Displacement Technologies in CA
- Future Activities and Opportunities

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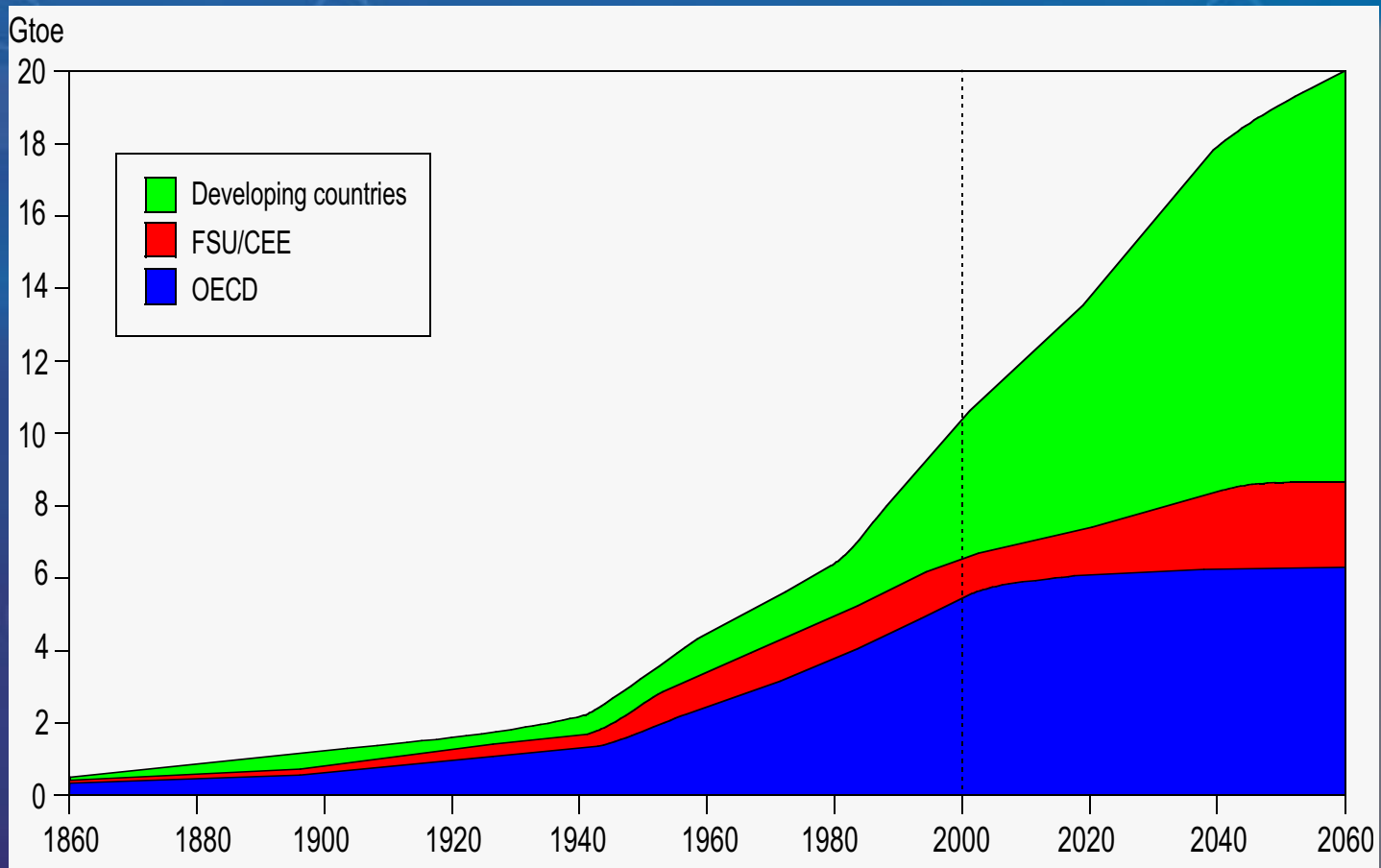
Global Demand "Shock" – Long Term Issue



Source: World Energy Council, World Bank.
The graph for the period 2000-2060 shows a scenario of future energy consumption based on current trends.

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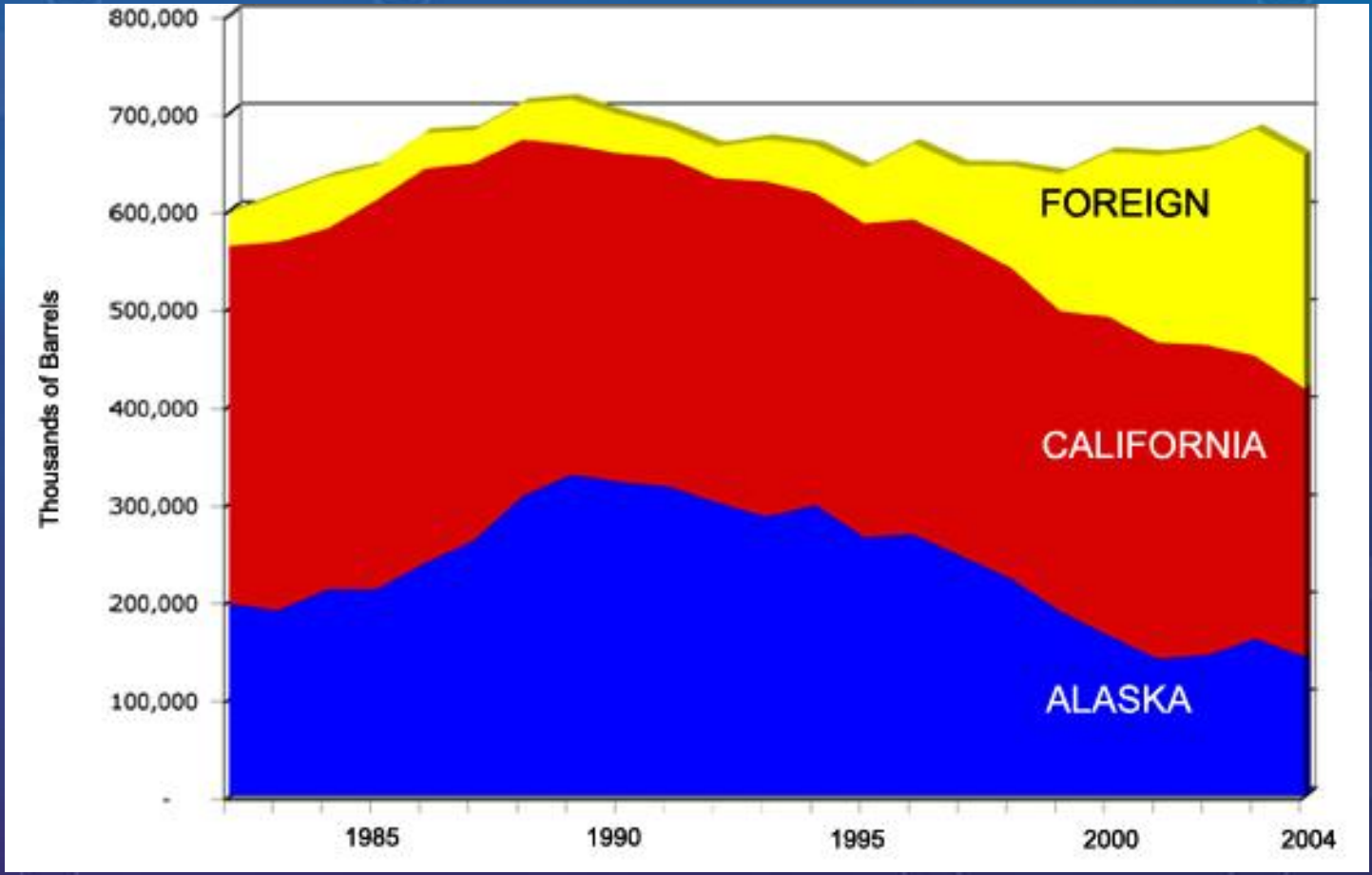
CA's Dependence on Foreign Crude Oil Has Tripled Over Last Decade



Source of crude oil for CA refineries (1980-2004)

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CA Petroleum Consumption Has Increased by 41% in Last 20 years

Source: EIA Transportation Sector Energy Consumption Estimates

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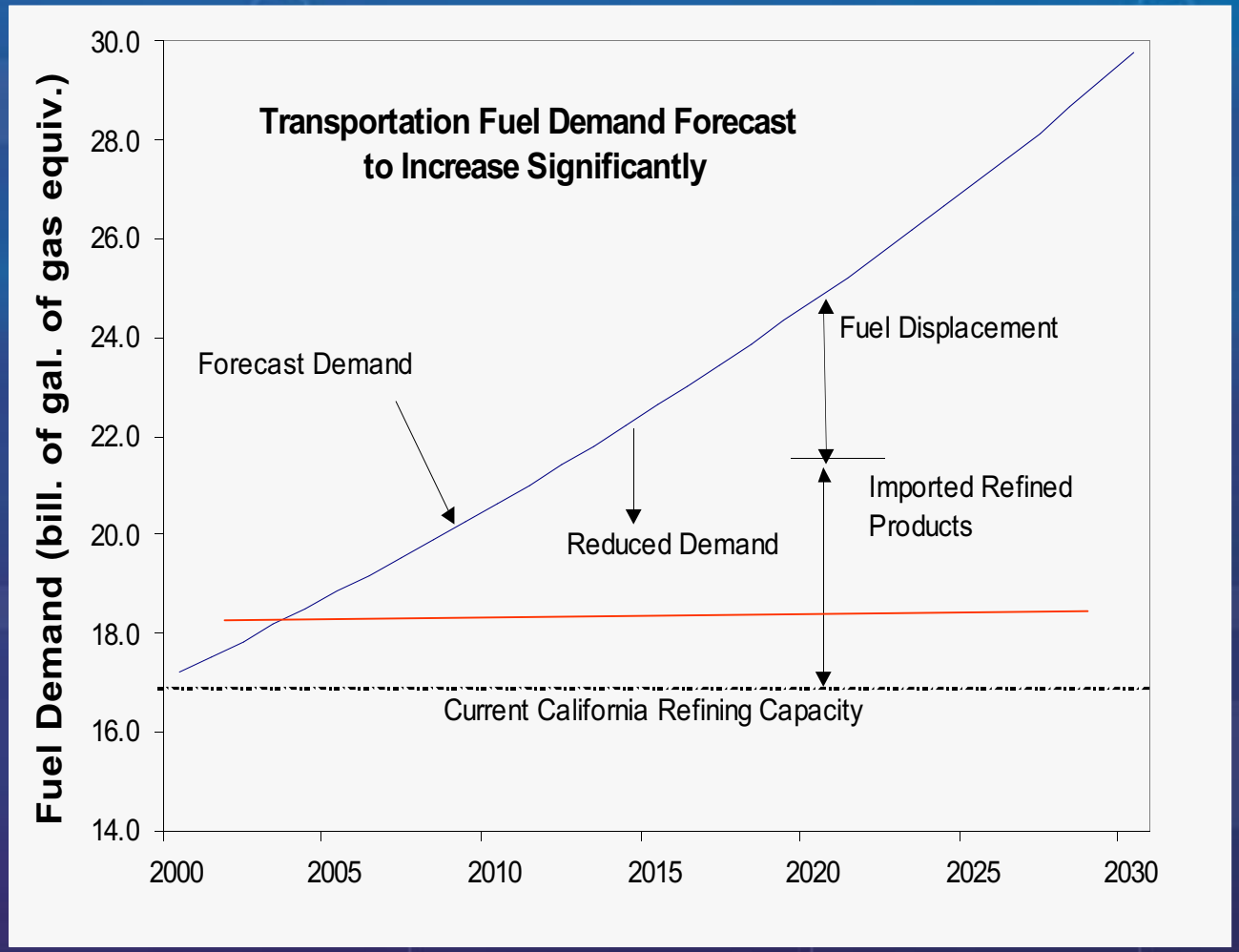
Imports to Meet Future Oil Needs in CA -- Unless Strong Action Taken



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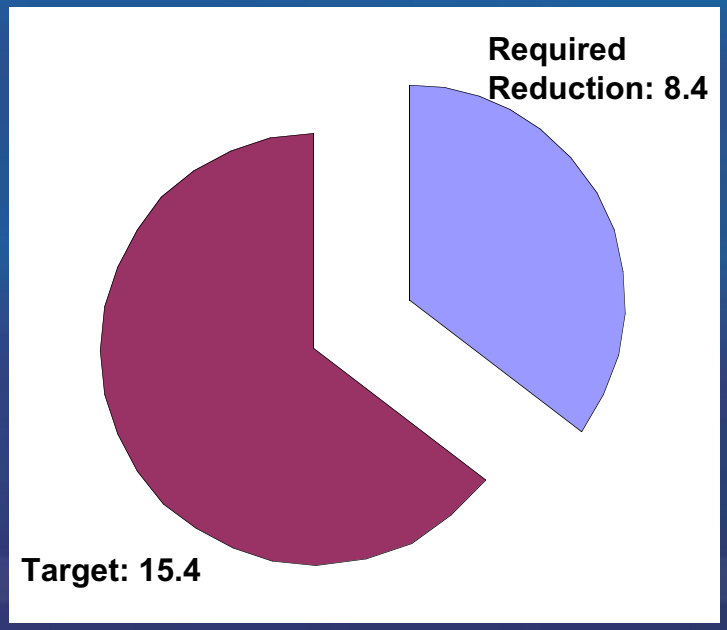
Source: California Energy Commission

Defining The Target: AB 2076 Goals

- California State Assembly Bill 2076 in 2000 directed the CEC and CARB to determine how the state should respond to the price spikes resulting from limited refinery capacity
- The CEC and CARB established two goals: 15% less gasoline and diesel consumed by 2020 and 20% alternative fuels
- In 2003 California used 18.1 billion gasoline gallon equivalents (GGE) of on-road gasoline and diesel
- Under "Business as Usual" Case CA demand will grow to 24 billion GGE by 2025



AB 2076 Report Goals: 15% less oil consumed and 20% alternative fuels in 2020

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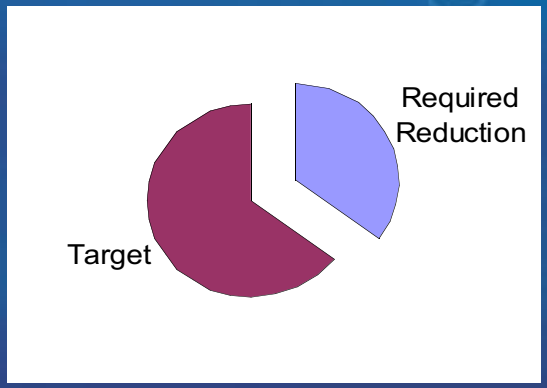
The CEC Identified Options – Feasible and Cost-Effective

Benefit from Sample Options In (Billions GGE/year)

- GHG standard: 2.82
- Mild Hybrids: 2.29
- Full Hybrids: 3.03
- Truck Standards: 2.30
- NG Trucks: 1.72
- Synthetic Fuels: 1.64
- Light-duty Diesels: 1.30
- Improved Maintenance: 0.63
- Truck-Stop Electrification: 0.34
- B-20: 0.99
- E-10: 0.48
- E-85: 1.00

Options from CEC



Required reduction is 8.40 BGGE per year

- Sum of slices needed = 8.40
- Partial options can help

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CA's Governor Has Set Ambitious Greenhouse Gas Reduction Goals

- By 2010 reduce GHG emissions to 2000 levels
- By 2020 reduce GHG emissions to 1990 levels
- By 2050 reduce GHG emissions 80% below 2000 levels

- *Transportation is responsible for >60% of CA's C02 emissions*
- *CA is the 12th largest emitter of GHG emissions in the world*

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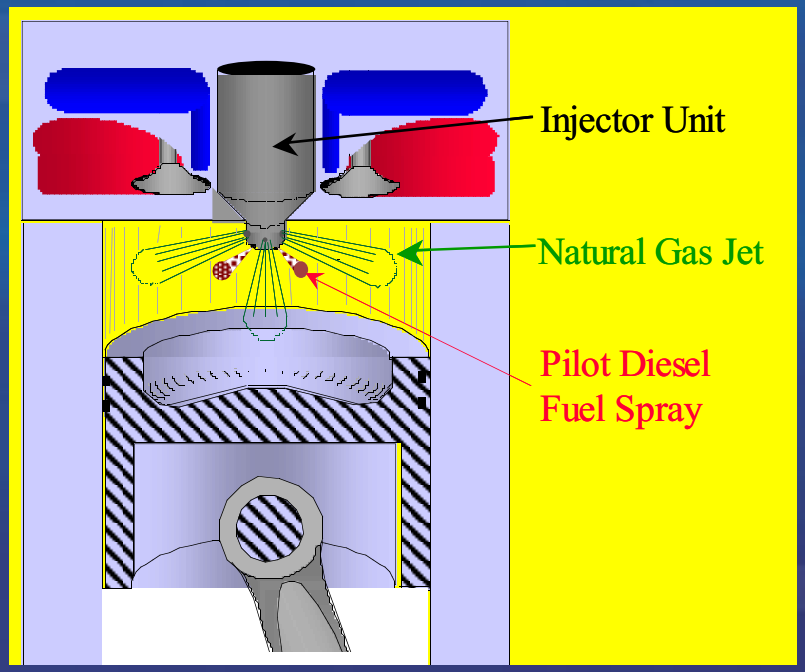
"HPDI" Natural Gas Technology



Diffusion Flame Combustion of Natural Gas Retains High Torque and Efficiency, but Burns much Cleaner

High Pressure Direct Injection with Diesel Pilot Ignition

- **Common-rail, direct injection fuel system**
- **Late-cycle injection of diesel – followed by natural gas – no premixed air and fuel**
- **Pilot diesel fuel for ignition - high percentage of gas used at all times (95-98% gas)**
- **Same performance as diesel, lower emissions**

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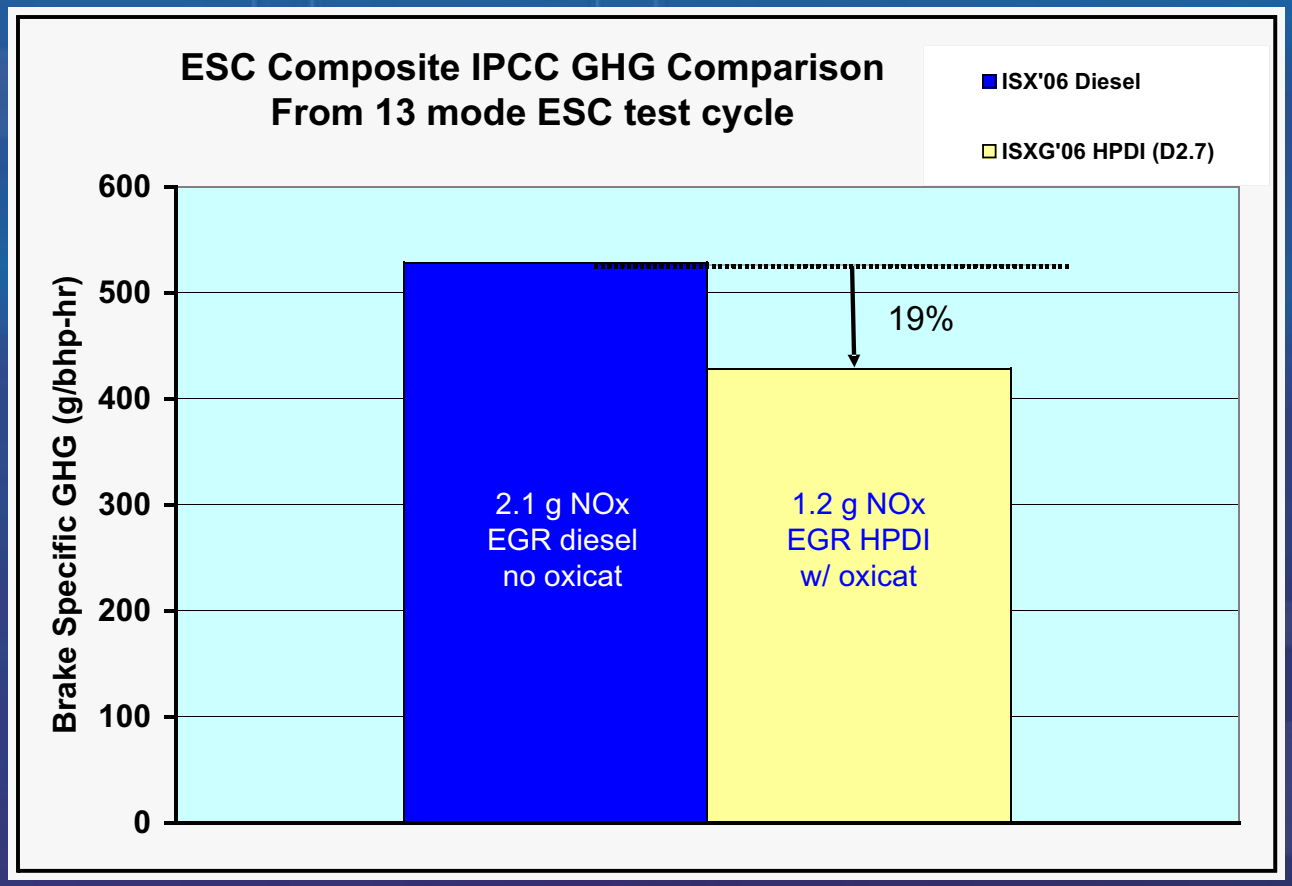
HPDI GHG Benefits



- Data from ESC 13 Mode Test Cycles
- Includes CH4 tailpipe emissions
- IPCC Calculation Method: GHG = (CO2 x 1) + (CH4 x 21) + ((3% x NOx) x 310)
- Dynamic gas rail pressure control leads to some fuel losses: could reduce GHG benefit to 15% in certain operation

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Hybrid Truck Users Forum (HTUF)

- Goal: Establish an economically viable U.S. hybrid truck industry for military and commercial purposes
- User driven process
- Joint WestStart-National Automotive Center (U.S. Army) program

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WestStart Provides $1M in DOD Funding to Reduce Cost of 20+ Trucks

October 2004: International Truck and Engine Announces Plans to Begin *Limited* Commercial Production in 2006

Utility Hybrid Work Truck

- 40-60% improvement in fuel economy
- Quiet – shuts off at work site
- 25kW export power (5 homes or small base)
- Exceeds performance of conventional trucks
- Lower emissions

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In Utility Truck Applications Hybrids Significantly Cut Fuel Usage

Fuel Use Reduction Over Baseline:

- Mission A – **40%** reduction in fuel use
- Mission B – **38%** reduction in fuel use
- Mission C – **58%** reduction in fuel use
- Mission D – **60%** reduction in fuel use

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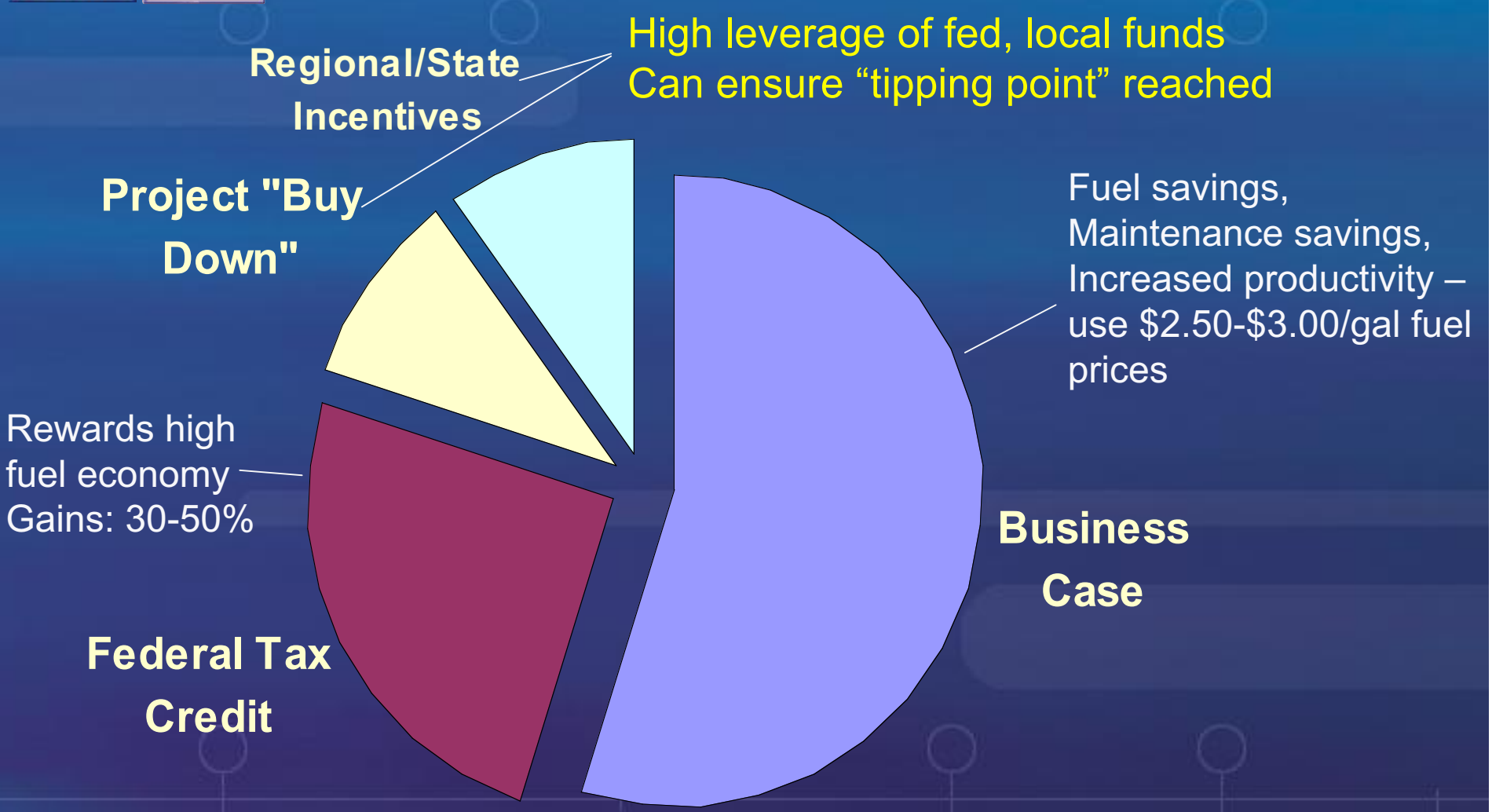
Hybrid Commercialization: Sharing Risk to Spur Volume



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What is CalSTEP?

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CalSTEP Overview

The California Secure Transportation Energy Partnership (CalSTEP) is a diverse and significant coalition of key stakeholders from the private, public, and non-governmental sectors who will work together to develop and implement a viable game plan to secure California's transportation energy future

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The CalSTEP Declaration

California can secure its own transportation energy future by 2020. This future will create more wealth and economic opportunity and be better for the environment.

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CalSTEP Committee Members -- Preliminary

- **James D. Boyd**, Commissioner, California Energy Commission
- **George Shultz**, Distinguish Fellow, Hoover Institute
- **Dr. Maxine Savitz**, The Washington Advisory Group
- **Dr. Jim Sweeney**, Professor of Management Science and Engineering, Stanford University
- **Lars Erik Lundin**, Vice President, Volvo Car Corporation
- **Dr. Beverly Scott**, General Manager, Sacramento RTD
- **Tim Carmichael**, President and Chief Executive Officer, Coalition for Clean Air
- **Bill Jones**, Chairman, Pacific Ethanol

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CalSTEP Committee -- Preliminary (cont.)

- **Dr. S.M. Shahed**, Vice President, Advanced Technology, Honeywell Turbo
- **Reg Modlin**, Director Energy and Environmental Planning, DaimlerChrysler Corporation
- **Maurice Gunderson**, Managing Director, Nth Power
- **Lee Stein**, Chairman, Stein & Stein (Investment Co.)
- **Fred Keeley**, Treasurer-Tax Collector, County of Santa Cruz (former Speaker Pro Tempore, State Assembly)
- **Doug Linney**, President, The Next Generation
- **John Boesel**, President and CEO, CALSTART

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Existing State Policies for Power Generation Applied to Transportation

Electricity (Existing)

- 20% Renewable Portfolio Standard by 2017 (2012 by E.O.)
- >$690 million per year spent on efficiency, renewable energy, and R&D
  - $140 million specifically for renewable energy incentives

Transportation (Don't exist)

- Alternative fuel portfolio – 20% by 2020
- $200 million per year to encourage use of alternative fuels and more efficient vehicles

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Summary

- CA Officials increasingly interested in measures to reduce oil consumption (global warming and security of supplies)
- Promising technologies and fuels exist but they are highly application specific
- HDV is extremely fragmented
- Potential opportunity for new CA HDV oil displacement programs

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