



U.S. Department of Energy
Energy Efficiency and Renewable Energy

freedomCAR & vehicle technologies program

Overview of FreedomCAR & Vehicle Technologies Program

**Dr. Phyllis Yoshida, Director
FreedomCAR and Fuel Partnership**



The Energy Efficiency and Renewable Energy Vision

A prosperous future where energy is clean, abundant, reliable, and affordable.

Specifically, an energy future where: ... ***Our cars and trucks*** will be more efficient and will be powered by a variety of clean domestic fuels and technologies that free us from dependence on foreign supplies of energy.

EERE'S # 1 Priority

Dramatically reduce or even end dependence on foreign oil



FCVT Program Goal

Lower Petroleum Consumption

Developing and accelerating the deployment of more energy efficient and environmentally friendly automobile and truck technologies that will enable America to use less petroleum.

Benefits

- Reduce dependence on oil through fuel substitution & higher efficiency in both passenger vehicles & commercial fleets.
- Reduce greenhouse gas emissions.

<u>Impacts</u>	2030	2050
Oil Savings (MBPD)	2.90	6.48
Carbon Emission Reduction (MM tons of carbon/yr)	117	260

FY2007 GPRA



FCVT BUDGET

Activity	Funding (\$ in thousands)				
	FY2004 Approp.	FY2005 Approp.	FY2006 Approp.	FY2007 Request	FY2008 Request
Hybrid Electric Systems	0	0	0	0	80,664
Vehicle Systems	13,875	13,004	13,056	13,315	0
Hybrid & Electric Propulsion	43,390	44,066	43,997	50,841	0
Advanced Combustion Engine R&D	52,736	48,480	42,746	46,706	34,550
Materials Technology	38,622	36,042	35,269	29,786	33,382
Fuels Technology	15,887	12,419	13,709	13,845	13,845
Technology Integration	0	0	0	0	13,697
Technology Introduction	4,802	4,944	6,250	11,031	0
Innovative Concepts	494	494	495	500	0
Technical/Program Mgt. Support	2,095	1,877	2,475	0	0
Biennial Peer Reviews	494	0	990	0	0
Congressionally Directed Activities	0	0	24,255	0	0
TOTAL	172,395	161,326	183,242	166,024	176,138
FreedomCAR & Fuel Partnership Activities	86,653	85,282	96,549	109,774	126,619
21st Century Truck Partnership Activities	76,339	70,055	45,267	42,021	29,792

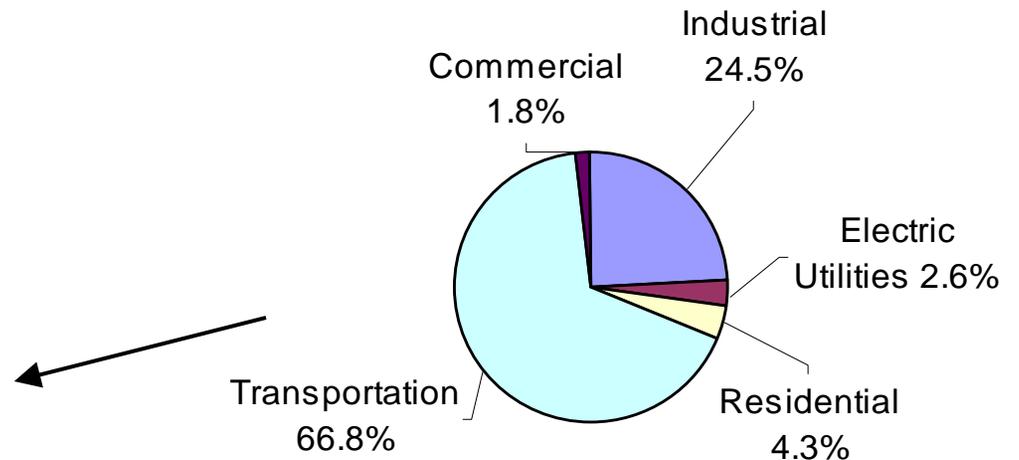
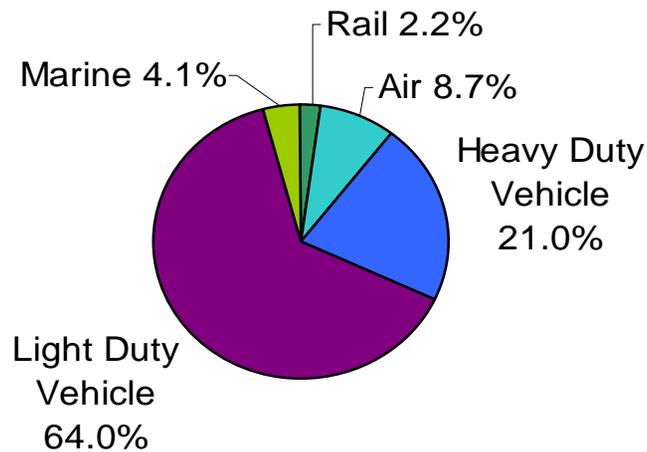


U.S. Petroleum Consumption

The Challenge

Petroleum Consumption by End-Use Sector

Transportation



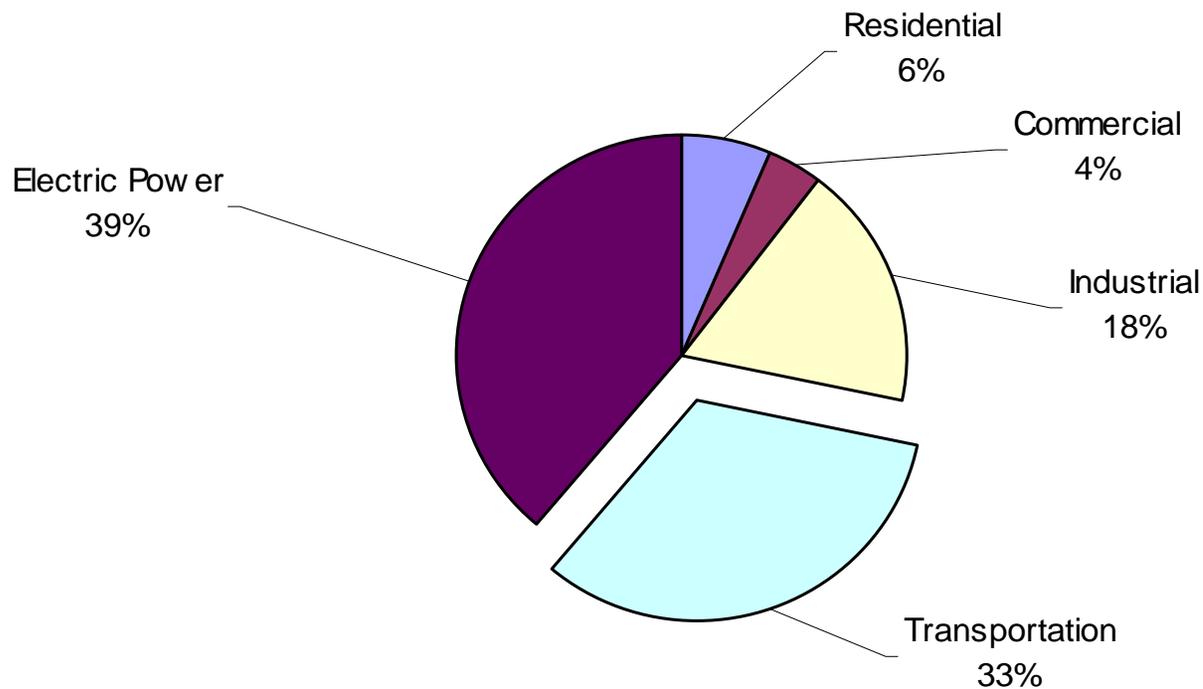
The transportation sector accounts for 67% of the oil use in the United States and is the fastest growing petroleum consuming sector.



Carbon Dioxide Emissions

The Other Challenge

Carbon Dioxide Emissions by End-Use Sector

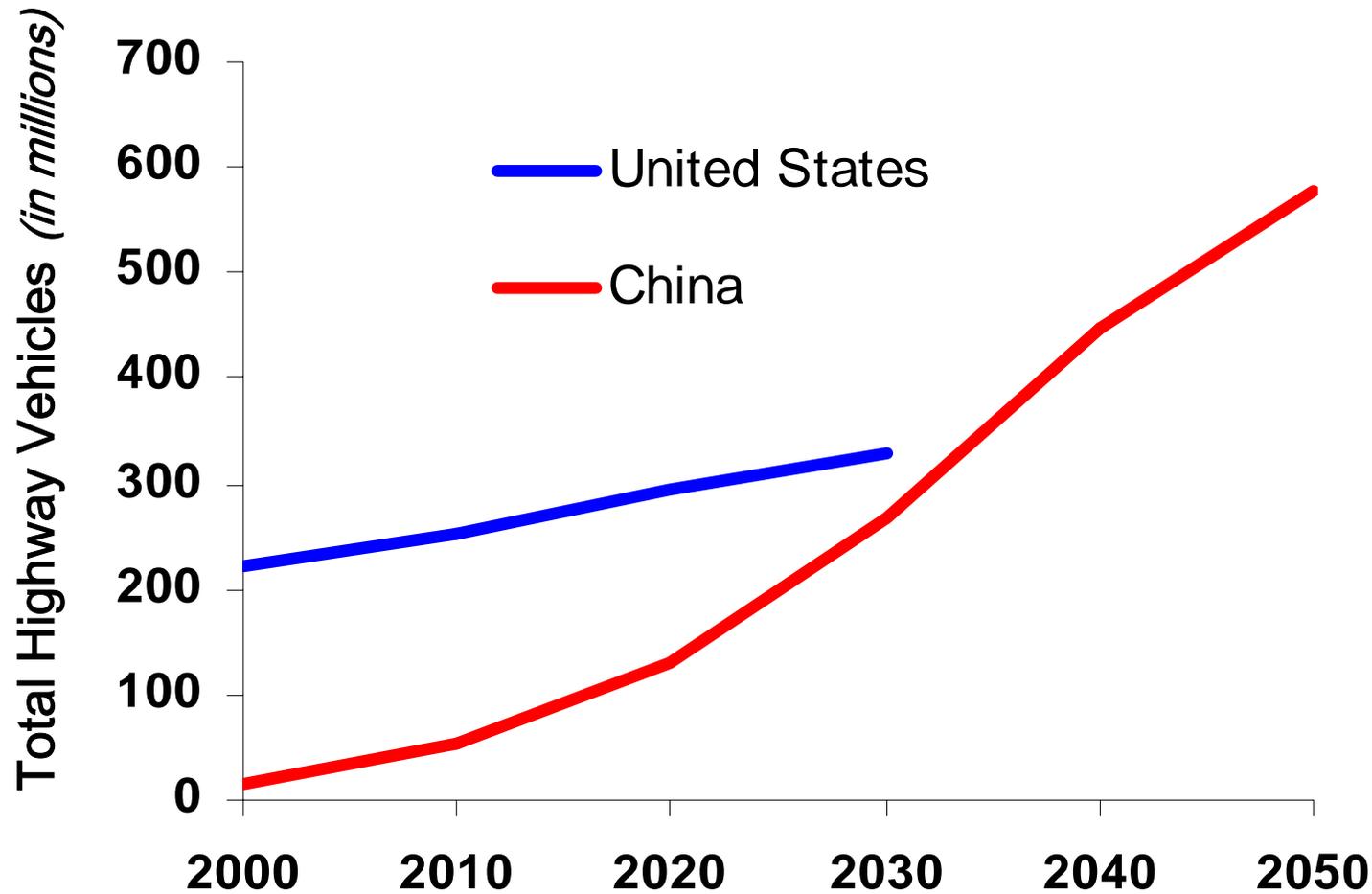


The transportation sector accounts for 1/3 of the carbon dioxide released in the United States and is the fastest growing source.



GLOBAL CONTEXT

→ China: Growth in Number of Vehicles in Use

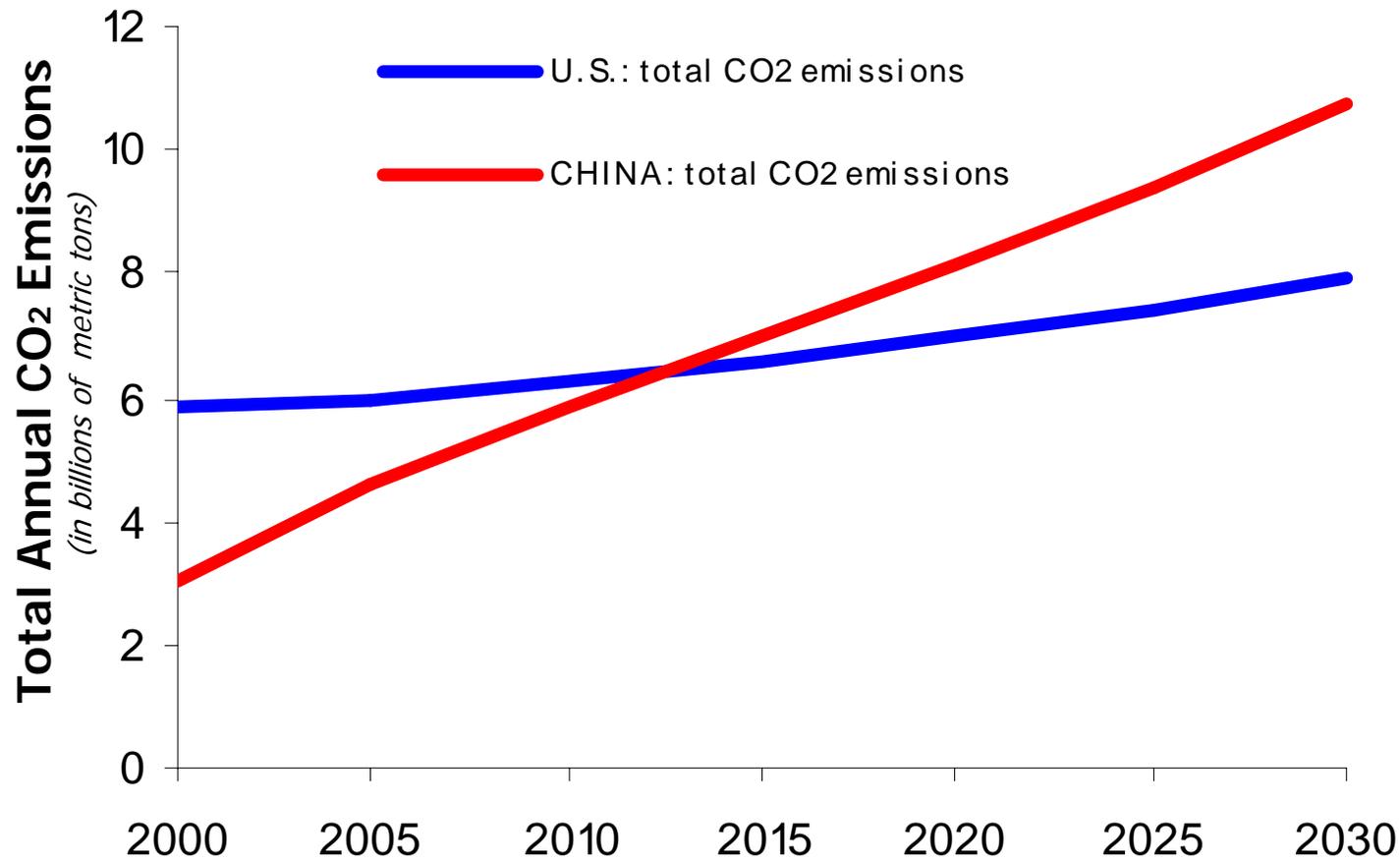


Source: USA Data: EIA, *Annual Energy Outlook 2007*. China Data: Argonne National Laboratory, "Projection of Chinese Motor Vehicle Growth," 2006.



GLOBAL CONTEXT

→ US & China CO₂ Emissions

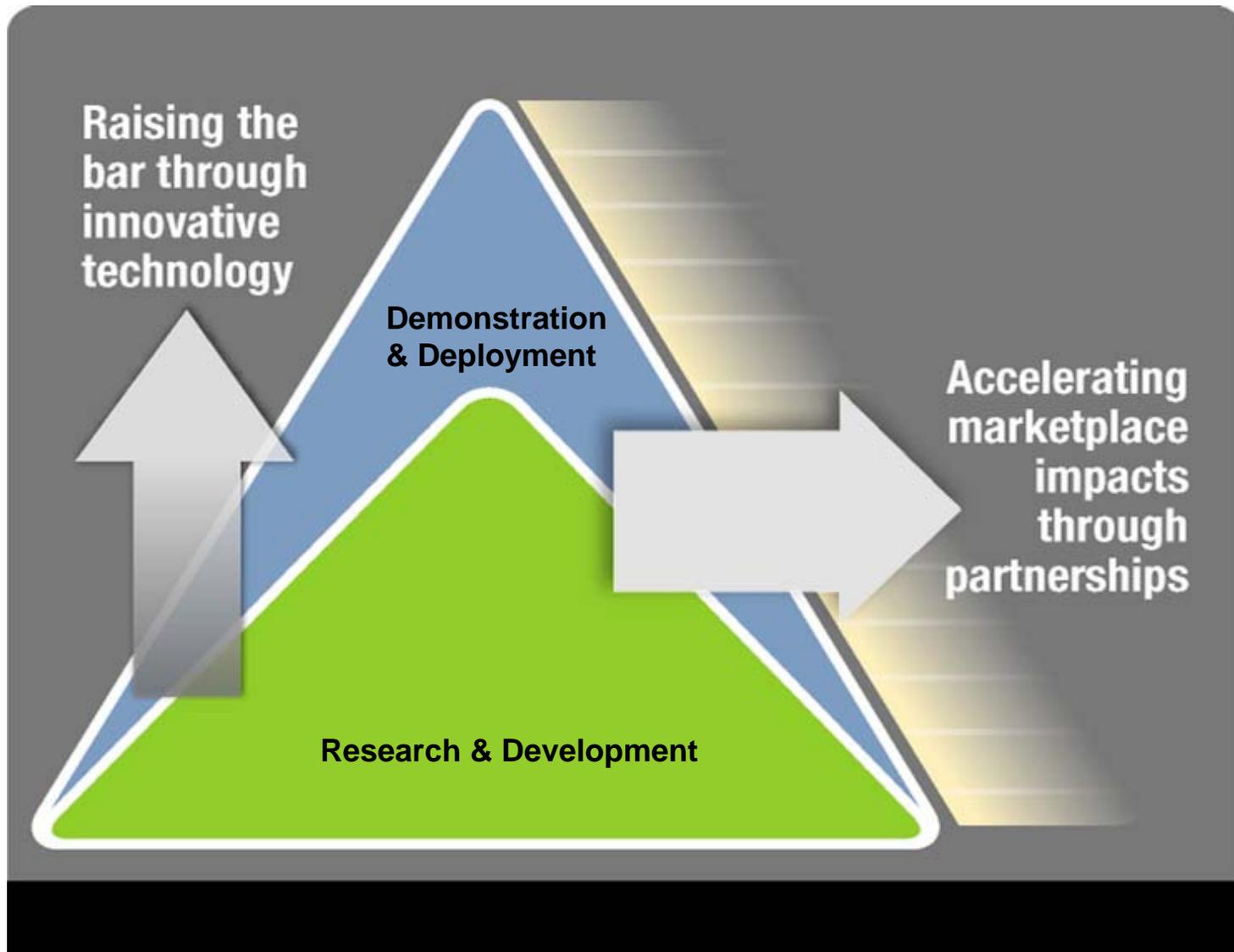


Source: Energy Information Administration: *Annual Energy Review 2005*, *International Energy Annual 2004*, *Annual Energy Outlook 2007*, & *International Energy Outlook 2006*.



Overcoming Our Addiction

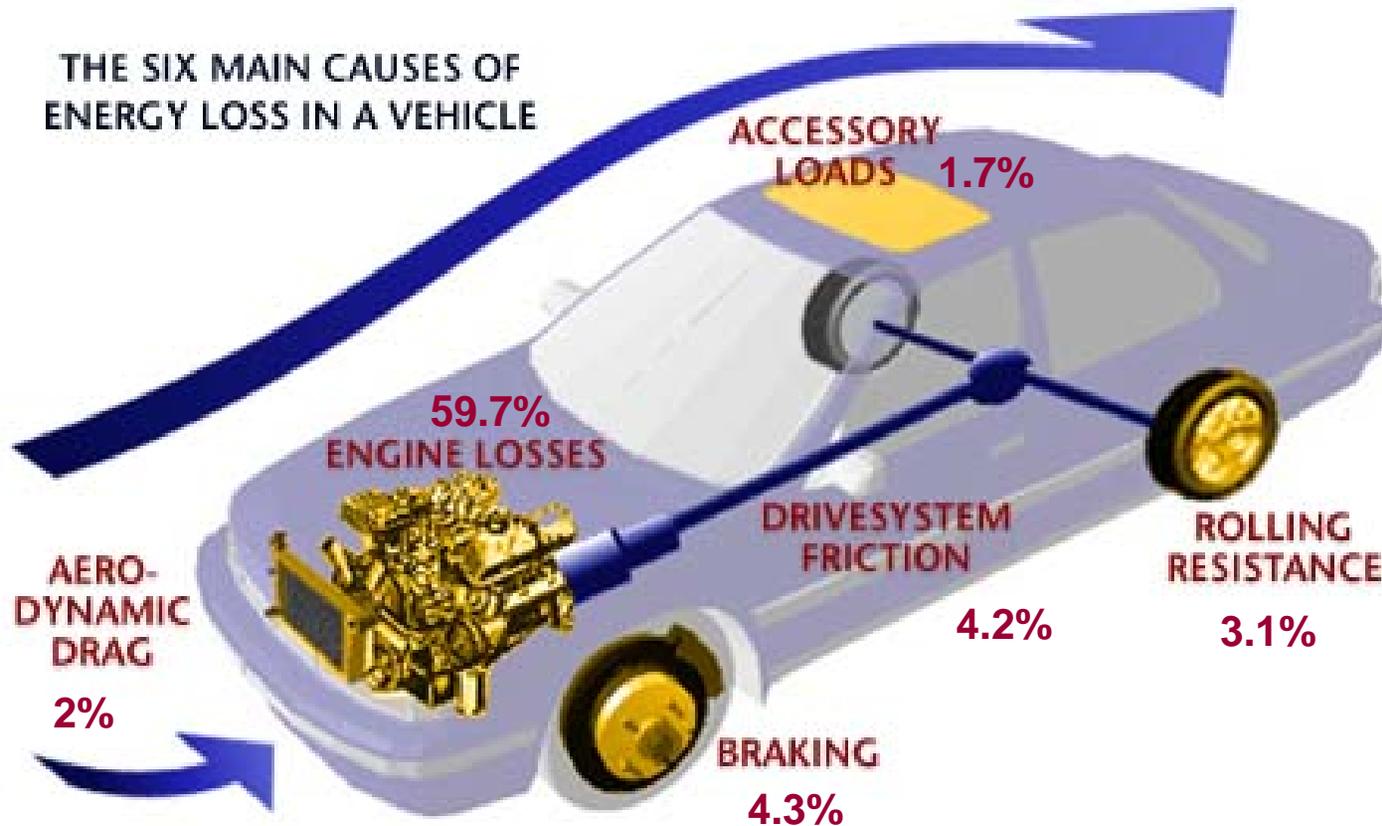
Begins with Efficiency & Fuel Substitution R&D





The Challenge

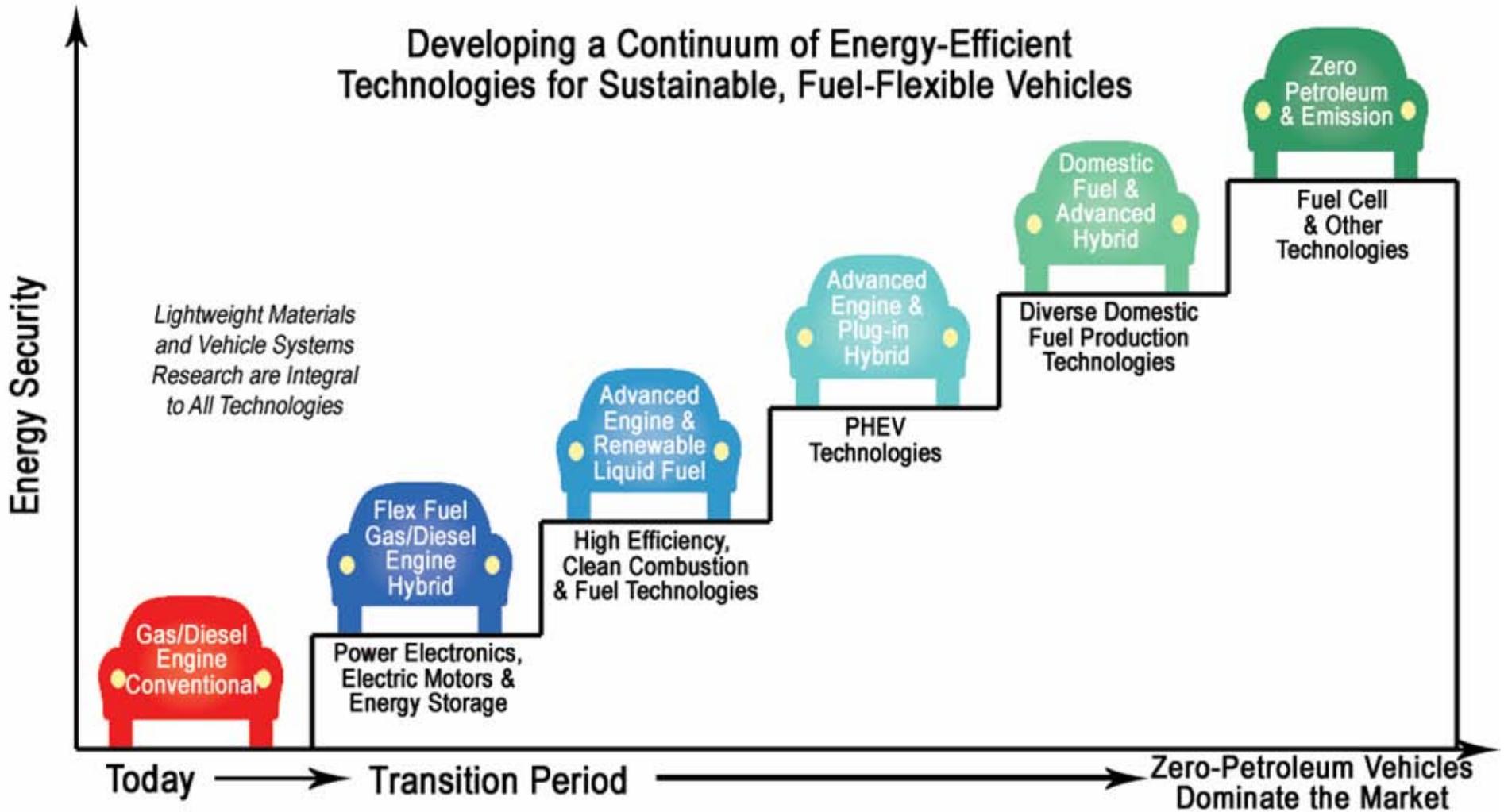
3/4 of the energy in every gallon is lost!



**Hybridization & Advanced Combustion Research
Address the Top Losses**



Strategic Approach to Future Transportation





Vehicle Technologies

Accelerating Results that make a Difference

Advanced Technologies for High Efficiency Clean Vehicles

Vehicle Systems

- Aerodynamics
- Rolling Resistance
- Systems Analysis and Target Setting



Tech Introduction

- EPACT
- Legislative & Rulemaking
- Clean Cities
- Validation
- Student Competitions
- GATE

Hybrid Propulsion

- Hybrid Electric Systems
- Power Electronics
- Advanced Batteries
- Inverters/Controllers
- Motors

Advanced Combustion Engines

- Low Temp. Combustion R&D
- Emission Controls
- Light- & Heavy-Duty Engines
- Waste Heat Recovery
- Health Impacts

Fuels Technologies

- Bio-Based Fuels
- HCCI Fuel Characteristics
- Fischer-Tropsch Fuels & Blendstocks
- Advanced Lubricants

Materials Technology

- Lightweight Structures
- Metal Processing
- Composite Development
- Processing and Manufacturing
- Design Data Test Methods
- Recycling Technology
- HTML



Technology Barriers

Research Seeks to Overcome These Hurdles

- **Components & Systems**
 - **Cost**
 - **Performance**
 - **Size and weight**
 - **Reliability**
- **High Volume Manufacturability**
- **Deployment & Infrastructure**



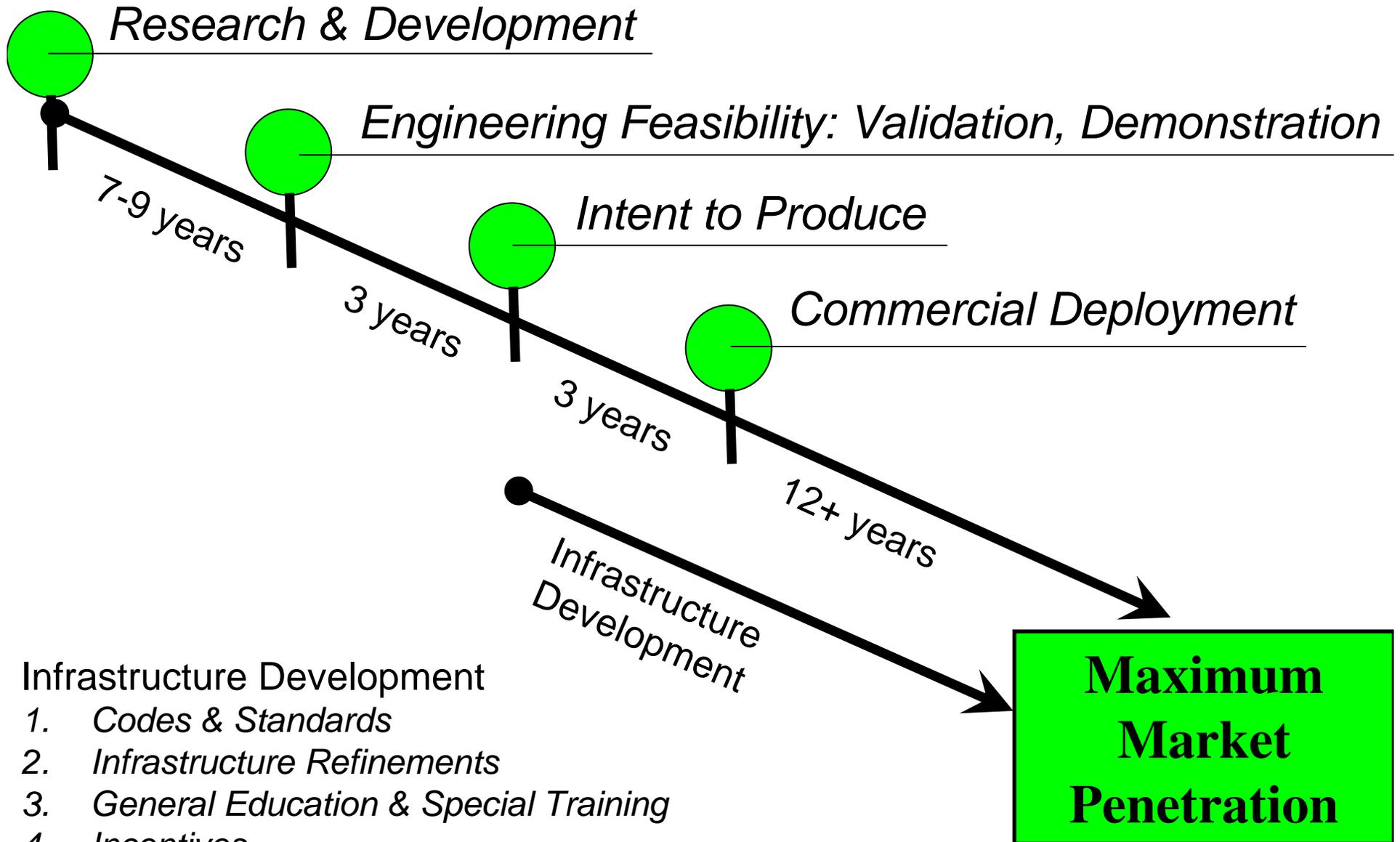
Top R&D Objectives

Priorities for Global Competitiveness

- **Hybrid Powertrains**
 - Motors and electronics
 - Reduce cost
 - Batteries
 - 15 year lifetime
 - 1/3 today's cost
- **Engines**
 - Optimize engine design for biofuels
 - Advanced combustion - lower emissions, higher efficiency



Research Success is Only the First Step Along the Pathway to Commercialization



Infrastructure Development

1. Codes & Standards
2. Infrastructure Refinements
3. General Education & Special Training
4. Incentives

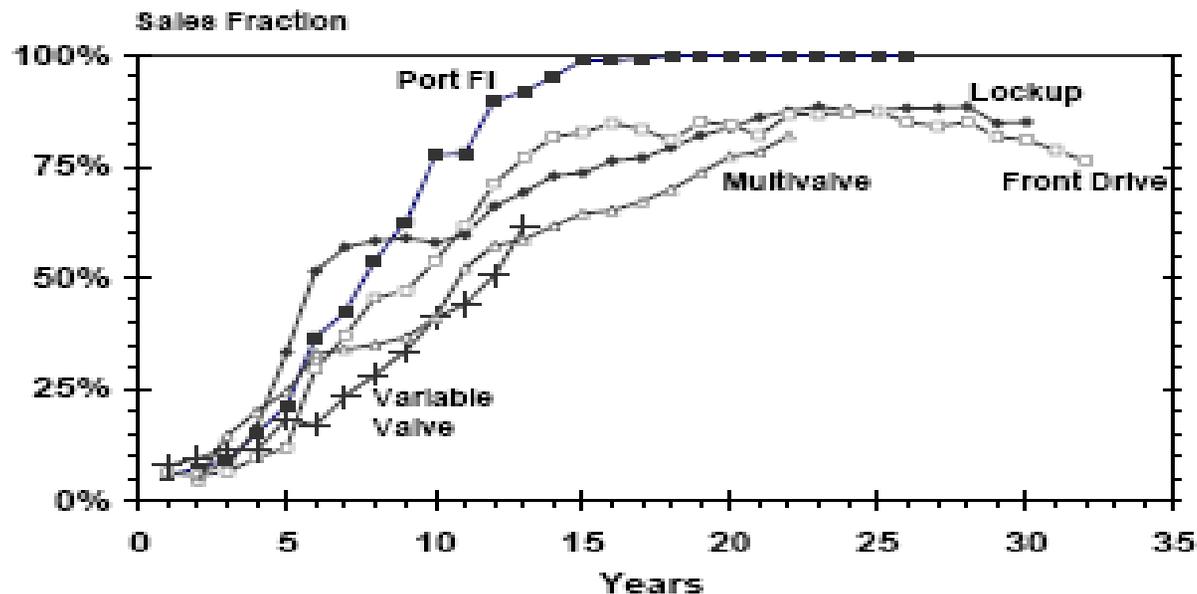


- **Consumer**
 - Limited market drivers (consumer perception that fuel price increases are temporary)
 - Incremental cost of technology
 - Relatively low fuel cost
- **Manufacturer**
 - High R&D cost
 - Cost of replacing sunk investments
 - Uncertain market – spurs compromise solutions
 - Pre-buys (heavy truck market)



Faster Market Penetration *Through early R&D investments*

It takes about 15 years for a technology to reach maximum penetration in new vehicle sales and another 15 years for the technology to be ubiquitous.



Policy and incentives can accelerate market penetration.



Examples of Major Technology Success Stories

Deployed Technologies	Technology Partners	Policy Implications	Market Impact
Low Sulfur Diesel Fuel	ORNL NREL	Informed EPA of sulfur effects from fuel research	40B gallons of low sulfur diesel fuel used annually
Nickel Metal Hydride Batteries	Cobasys	Royalty payments to Treasury	Every US Hybrid Vehicle sold has IP from this battery research
Quick Plastic Forming of Aluminum	GM PNNL ORNL	Higher Energy Efficiency	Chevrolet Malibu MAXX 2004, Cadillac and GM Vehicles
Light Duty Diesel Engine	Cummins ORNL SNL	Higher Energy Efficiency for Light Vehicles	Agreement with DaimlerChrysler for 2009 volume production



- **Current Projects**
 - DOE funded 16 state projects in FY 2006 to Increase Use & Availability of Alternative Fuels
 - Clean Cities Coalitions (>90)
 - Testing Plug-in Hybrid Vehicles for NYSERDA
- **Further Opportunities**
 - Vehicle testing with other state agencies
 - Gathering state data on alternative fuel usage, market drivers, and market roadblocks