



Increasing Energy Efficiency: Expanding the Opportunities

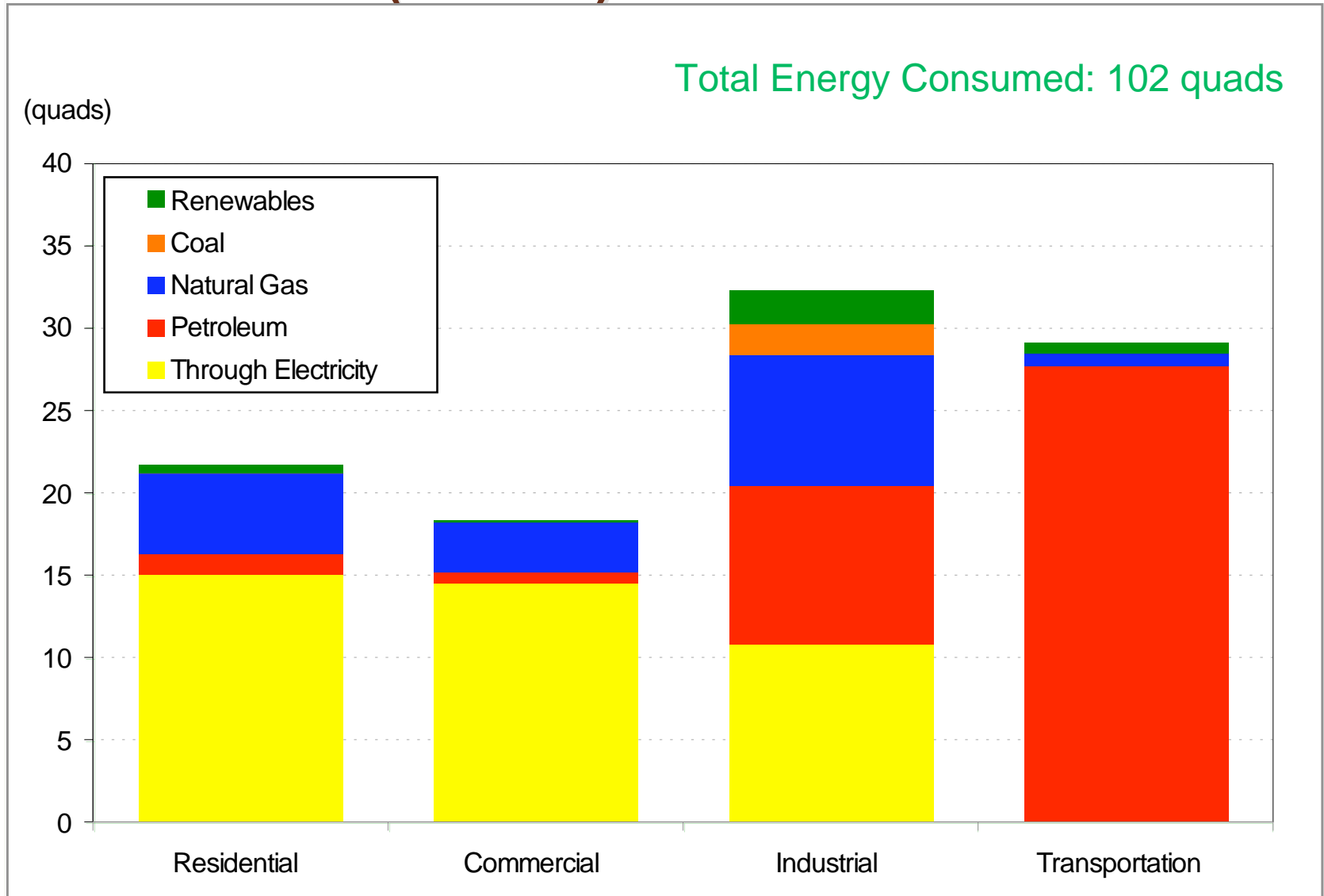
Maxine L. Savitz

NAE-AAES Convocation

Session on America's Energy Future

April 20, 2009

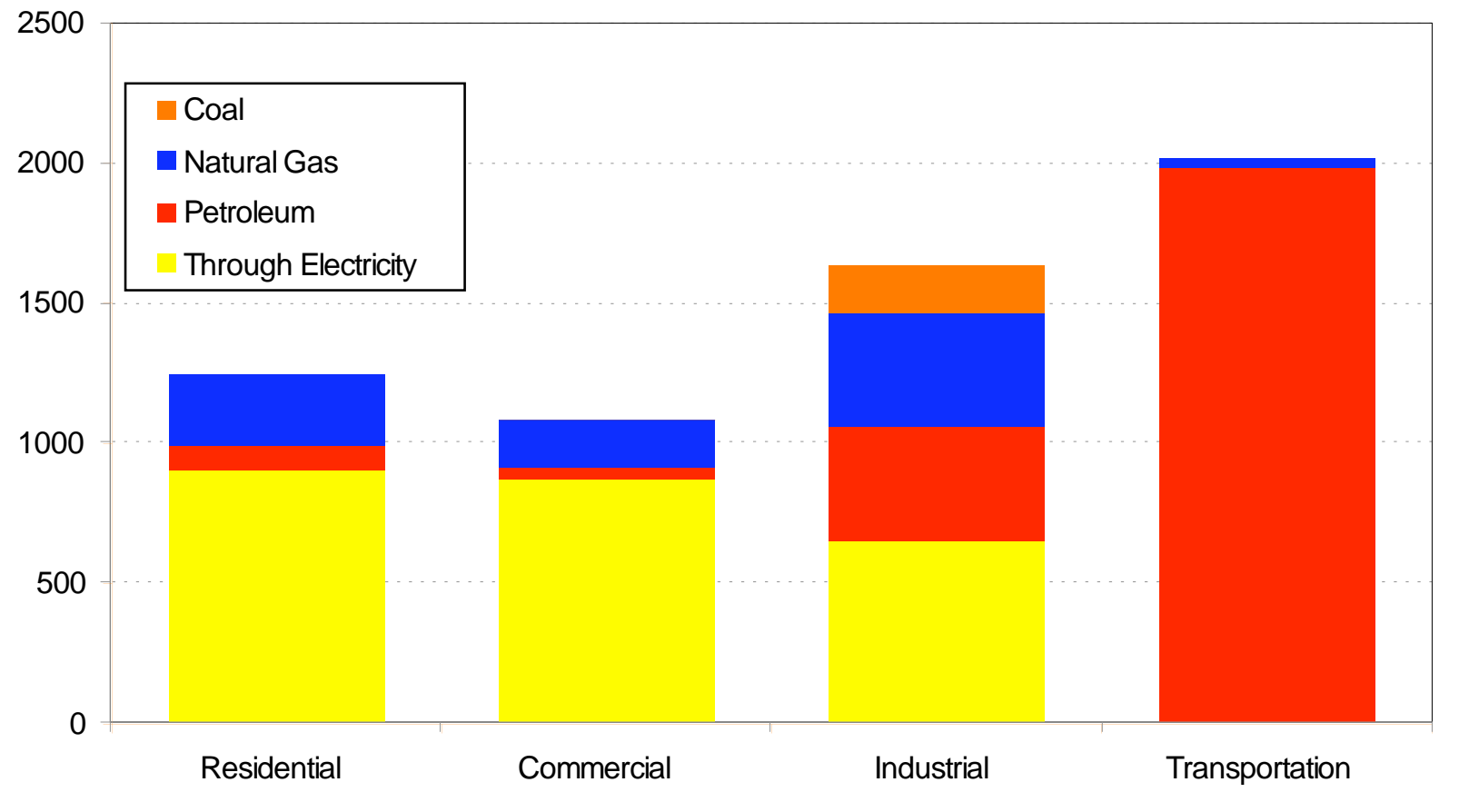
U.S. Delivered Energy Use by Sectors (2007)



U.S. Delivered CO₂ by Sector

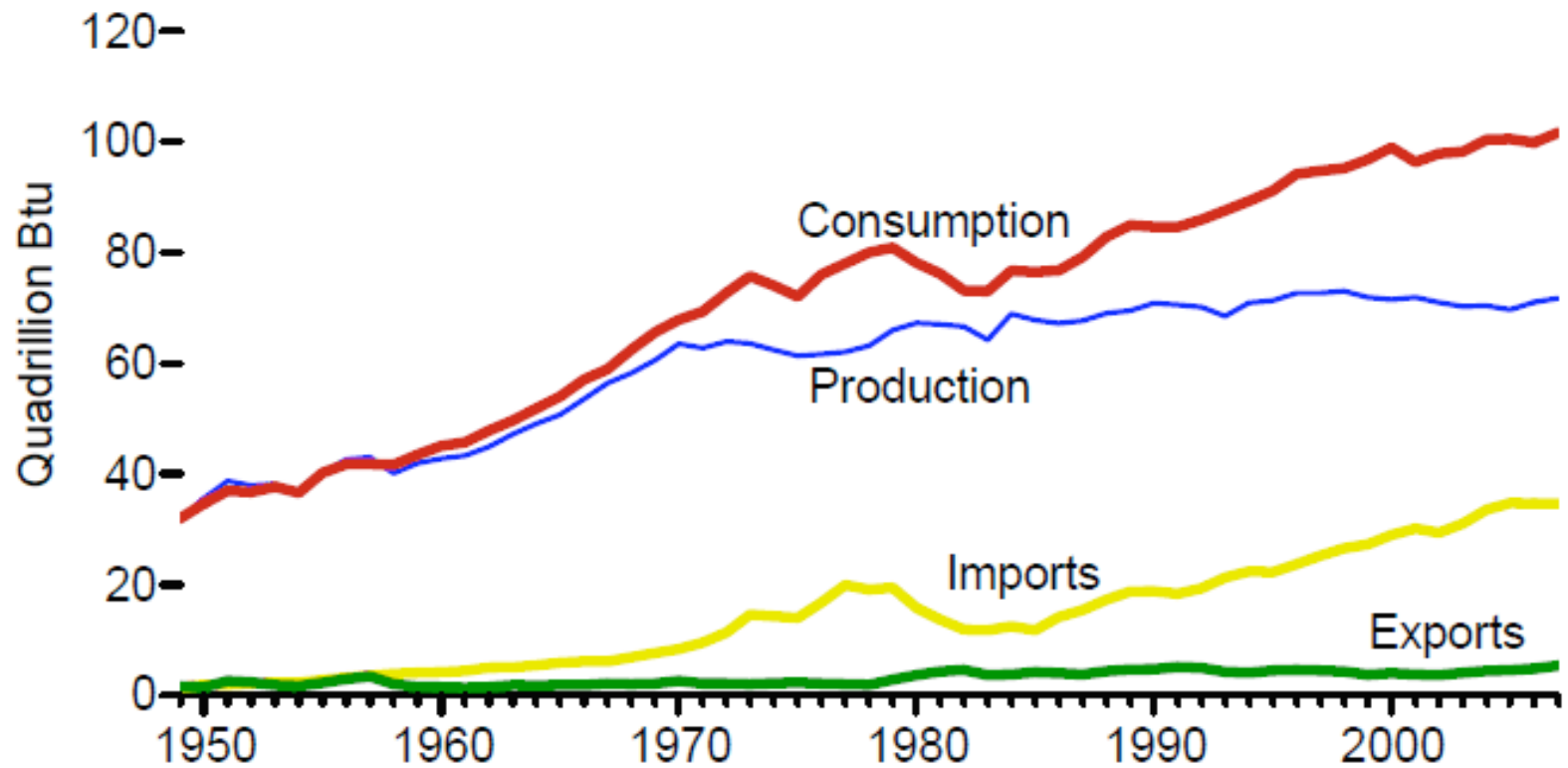
(Million
Tonnes
CO₂)

The Power Plant CO₂ Heads for the Sky,
Most Electrons Head for Buildings!



U.S. Energy Overview (1950-2007)

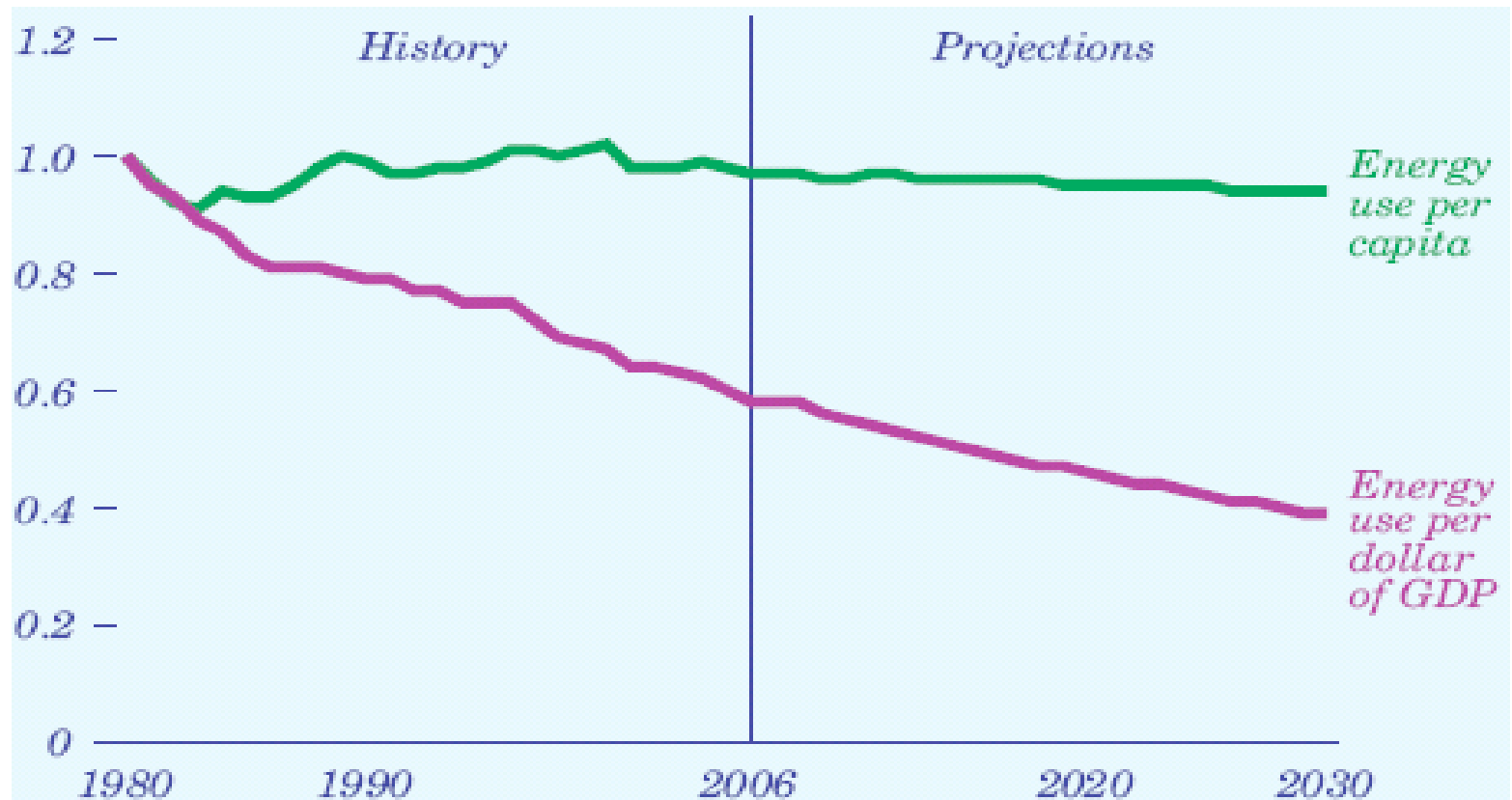
U.S. Dependence on Imports Continues to Increase



Source: Energy Information Administration, 2008

Energy Use Per Capita and Per Dollar of GDP (1980-2030)

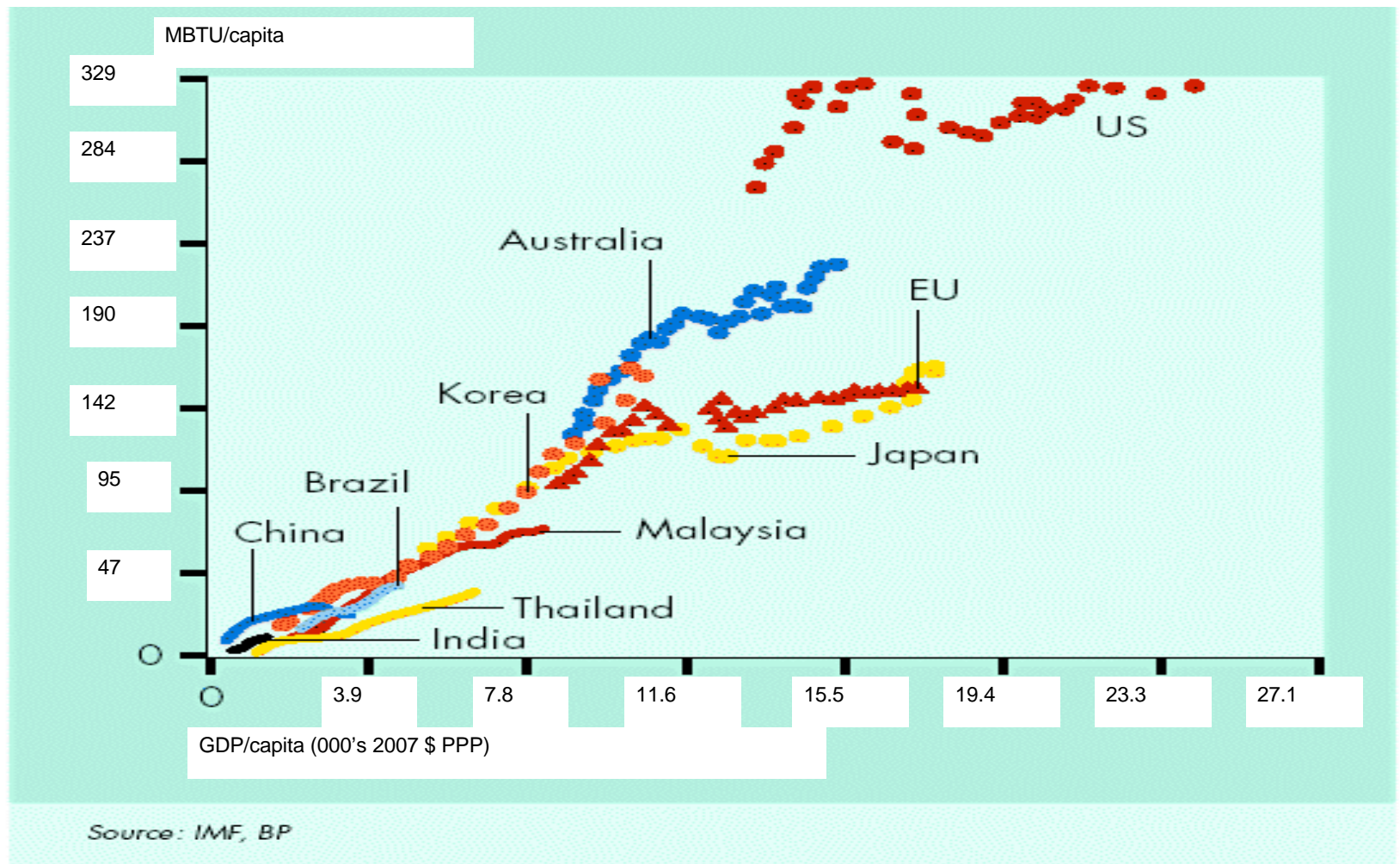
Energy Efficiency Accounts for 70 Percent of Decline



Source: Energy Information Administration, 2008

International Energy Use as a Function of GDP

U.S. Uses More Energy Per Dollar of GDP than Other Developed Countries

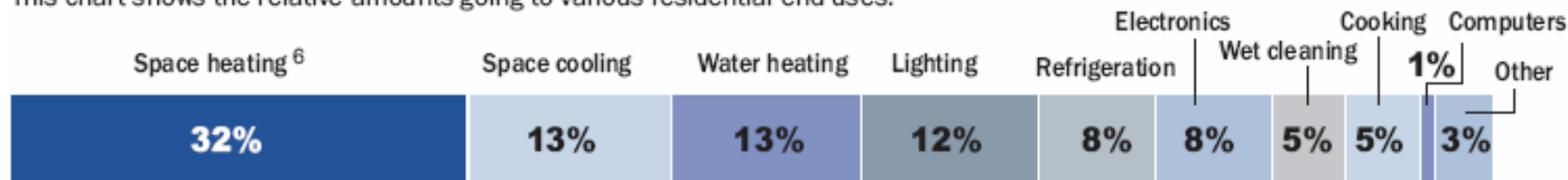


Energy Usage in U.S. Residential & Commercial Sectors

Growth in Energy Usage in Buildings Could be Reduced 30 Percent from Projected Increase by 2030 (APS Finding 1)

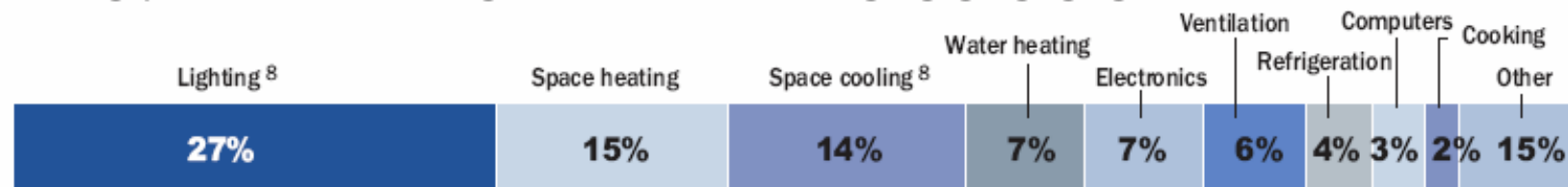
Residential energy end usage

In 2006 the residential sector consumed 21.8 quads⁴ of primary energy. This chart shows the relative amounts going to various residential end uses.⁵



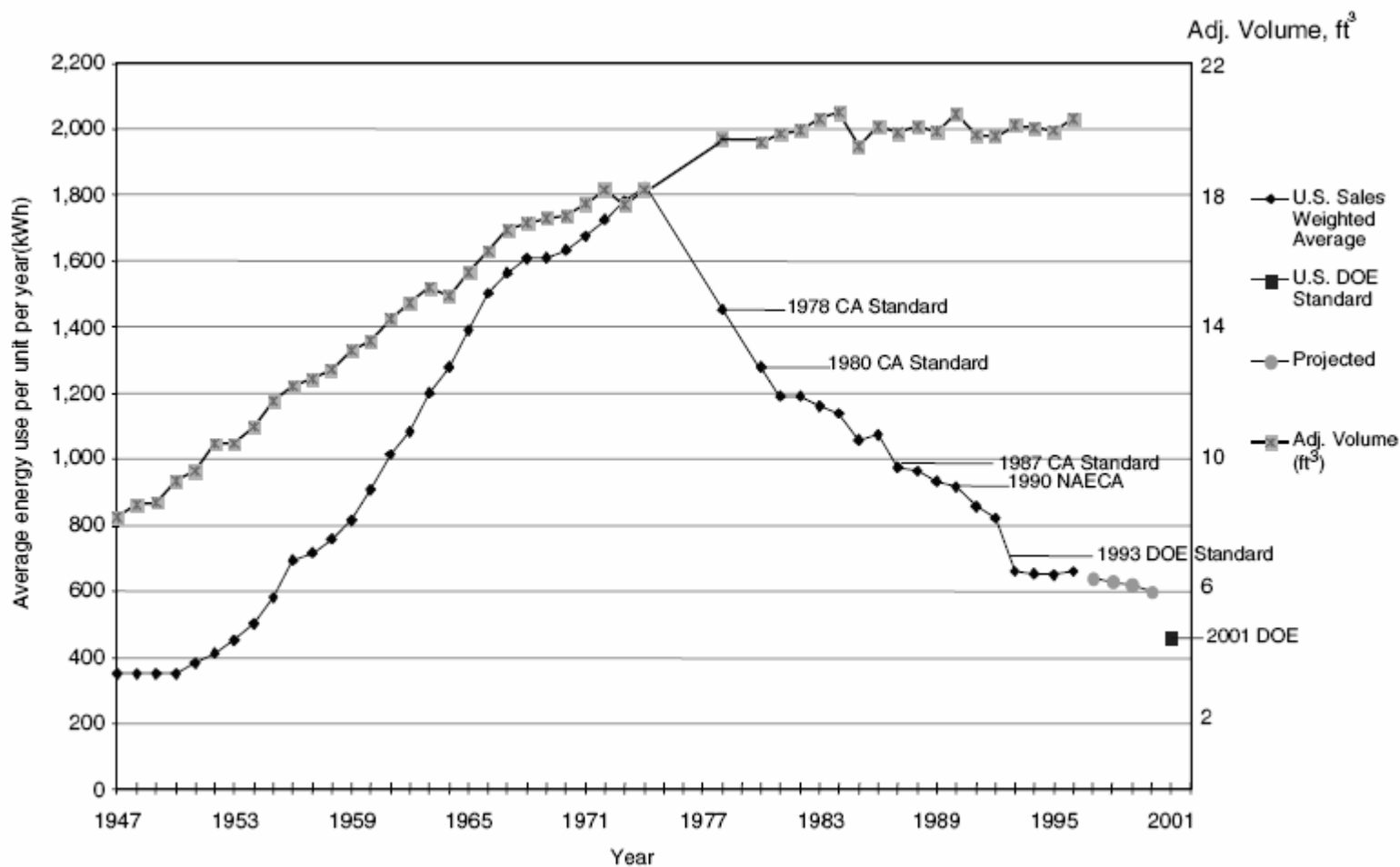
Commercial energy end usage

In 2006 the commercial sector consumed 17.9 quads of primary energy. This chart shows the relative amounts going to various end uses.⁷ The category "Other" includes non-building commercial use such as street lighting, lighting in garages, etc.



Electricity Consumed by Refrigerators, 1947-2001

Technology and Standards Effective for Increasing Energy Efficiency

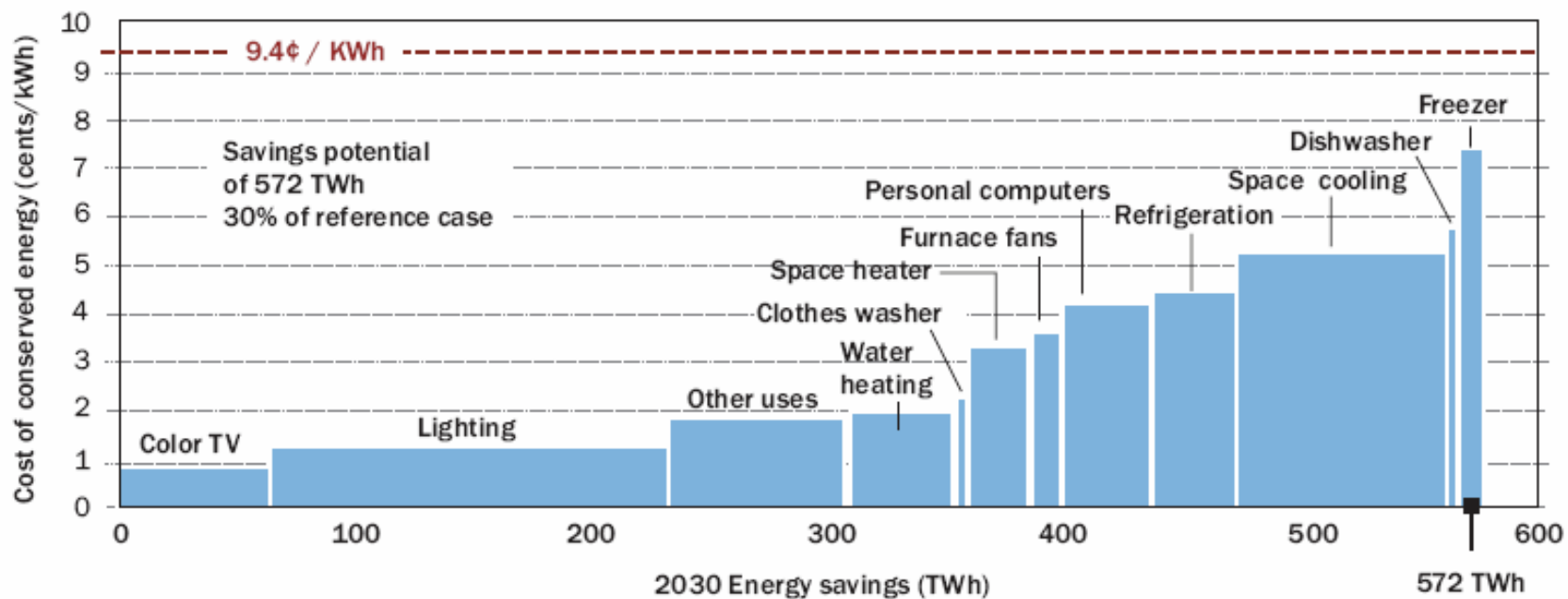


Source: National Research Council (2001),

Residential Electricity Savings Potential (2030)

Residential electric savings potential for year 2030

Conservation supply curve for electric energy-efficiency improvements in the residential sector. For each measure considered, (the energy savings is achieved at a cost per kWh less than the average residential retail price of 9.4 cents/kWh, shown as the horizontal red dashed line.



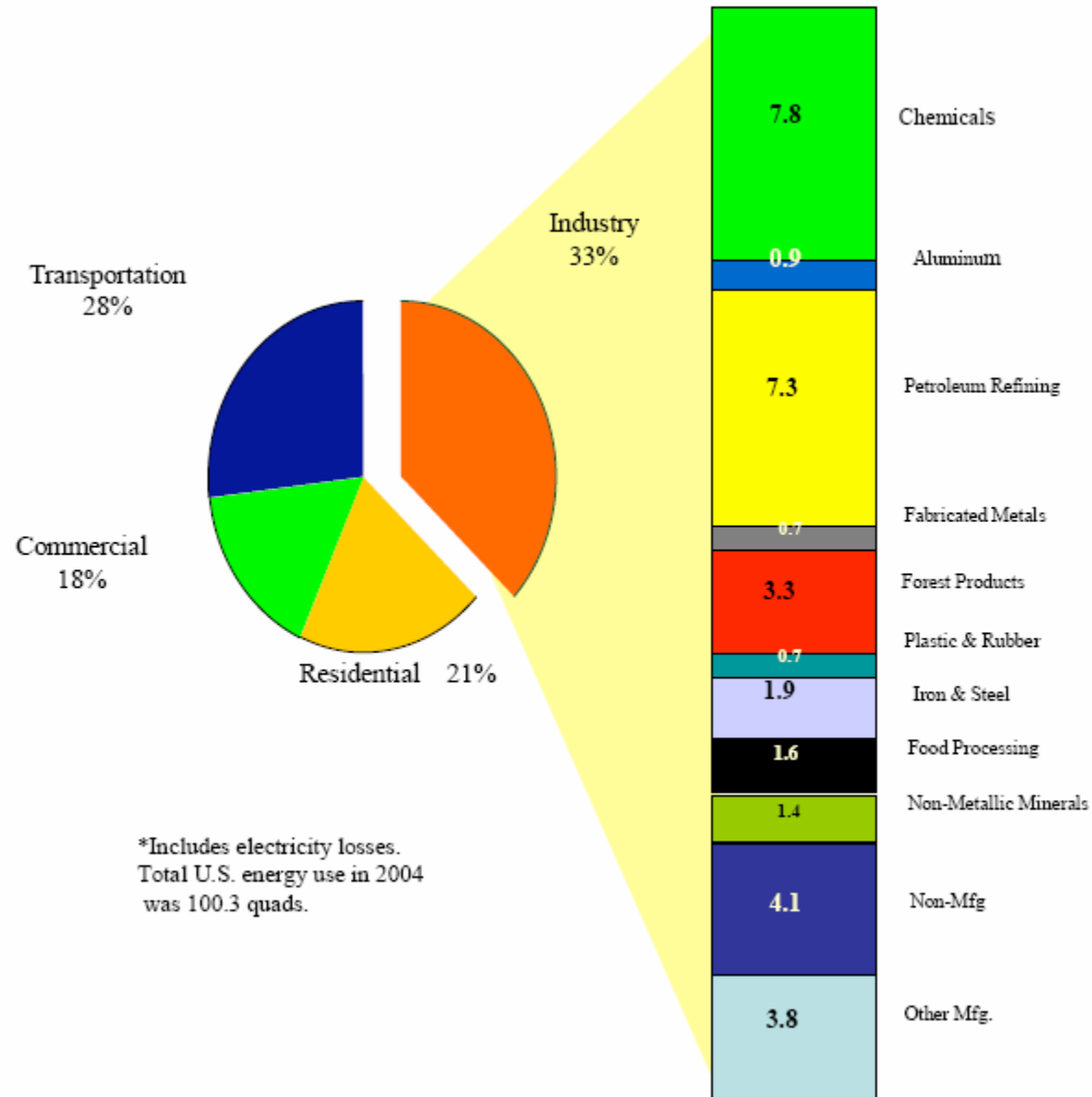
Source: American Physical Society (2008)



Advanced Technologies Provide for Additional Energy Efficiency

- Solid state lighting
- Advanced windows
- Integrated cooling systems
- Low-energy and zero-net energy new homes
- Low-energy new commercial buildings

Total Energy Use in the Industrial Sector (20⁰⁴)



*Includes electricity losses.
 Total U.S. energy use in 2004
 was 100.3 quads.

Estimated Energy Savings Due to Energy Efficiency Improvements

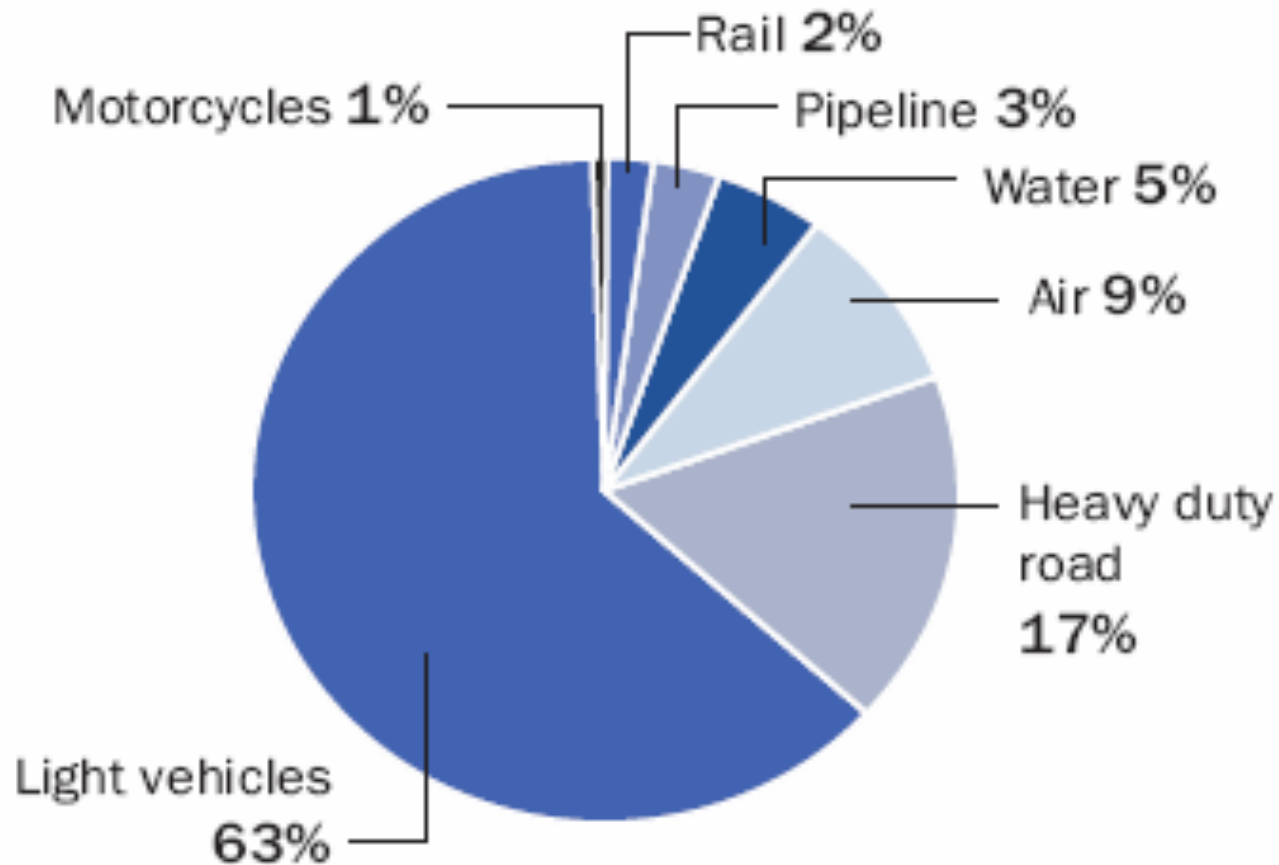
<i>(quads)</i>					
<i>INDUSTRY</i>	<i>ENERGY USE IN INDUSTRY</i>			<i>SAVINGS OVER BAU IN 2020^{(1),(2)}</i>	
	<i>2007</i>	<i>BAU PROJECTION (DOE/EIA REFERENCE CASE)</i>		<i>SAVINGS IN 2020^{(1),(2)}</i>	
		<i>2020</i>	<i>2030</i>		
Petroleum Refining	4.09	6.07	7.27	0.77 – 2.81	
Iron & Steel	1.38	1.36	1.29	0.21 – 0.76	
Cement	0.44	0.43	0.41	0.04 – 0.39	
Bulk Chemicals	6.85	6.08	5.60	0.30	
Pulp & Paper	2.15	2.31	2.49	0.53 – 0.85	
Total Savings – All industries (including those not shown)				4.9 – 7.7 ⁽³⁾ 14% - 22%	
NOTES					
(1) Based on a review of studies for specific major energy-using industries, for industrial combined heat and power (CHP), and for industry as a whole.					
(2) Savings shown are for cost-effective technologies, defined as those providing an internal rate-of-return of at least 10%.					
(3) Includes 0.7 – 2.0 quads from CHP systems.					



Cross-sectoral Technologies to Provide Additional Savings

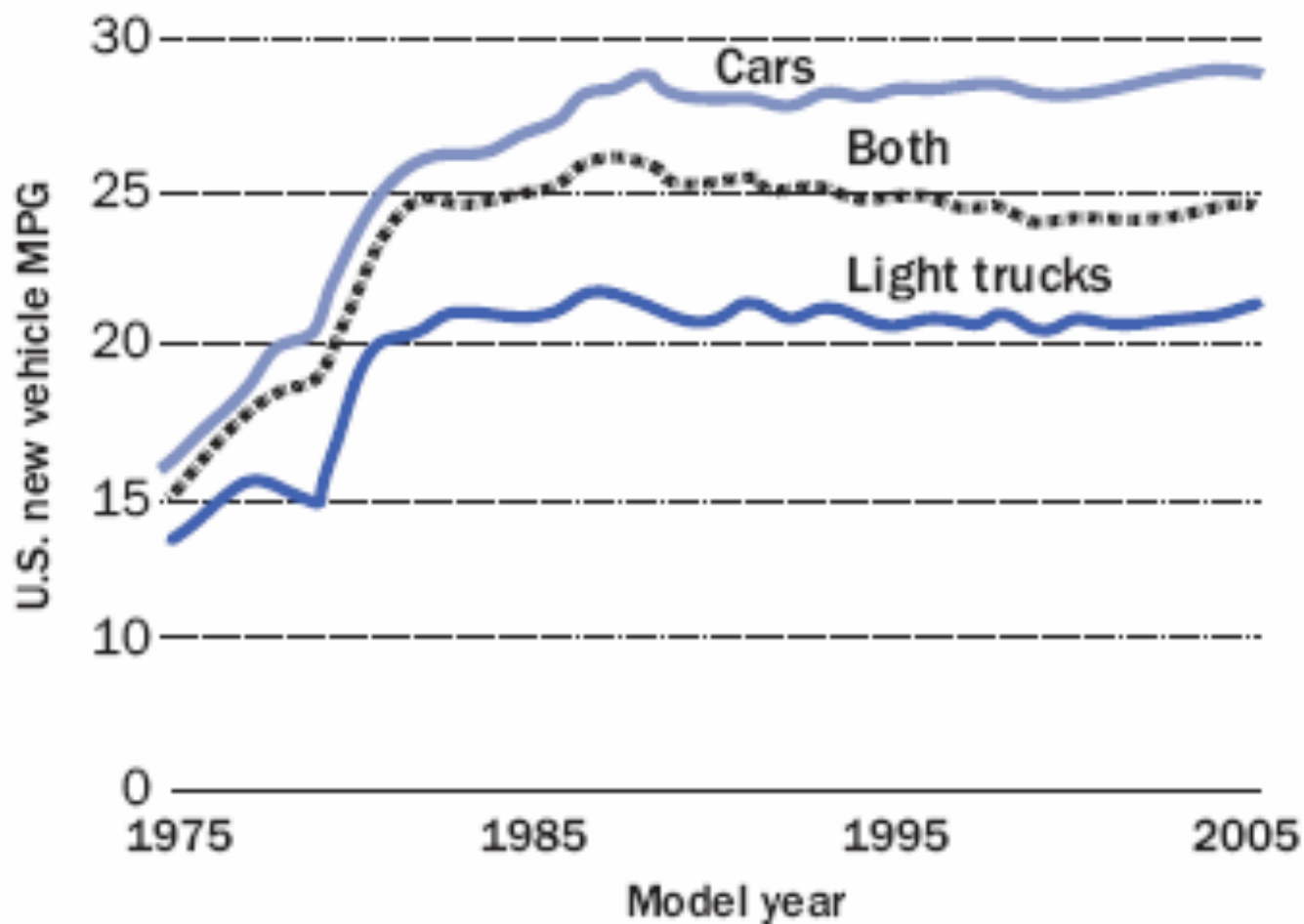
- Combined heat and power
- Materials, nanotechnology
- Alternative feedstocks
- Steam and process heat
- Separation
- Sensors and controls

U.S. Transportation Energy Consumption by Mode



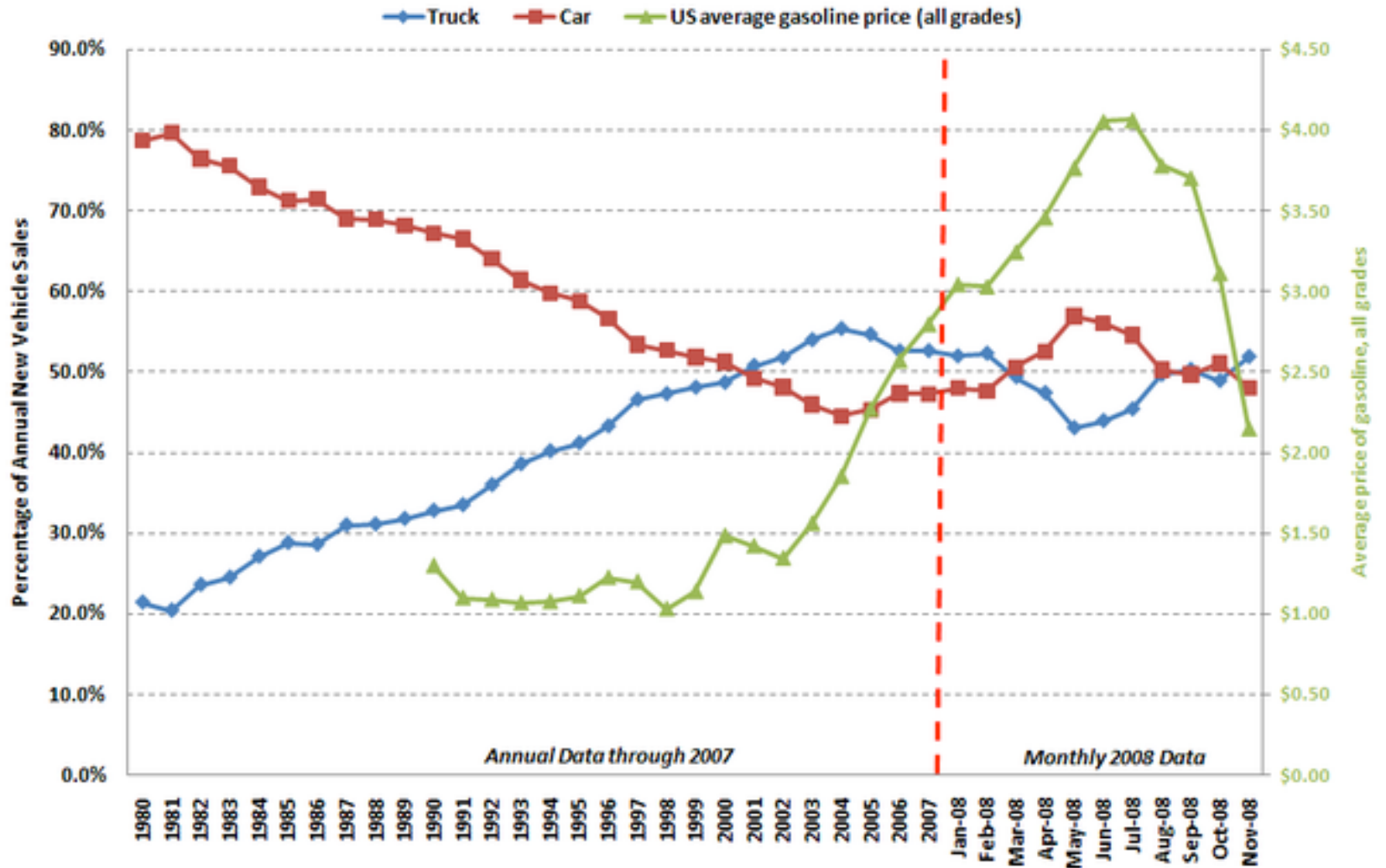
Source: American Physical Society (2008)

Fuel Economy of U.S. Light Duty Vehicles and Trucks (1975-2005)



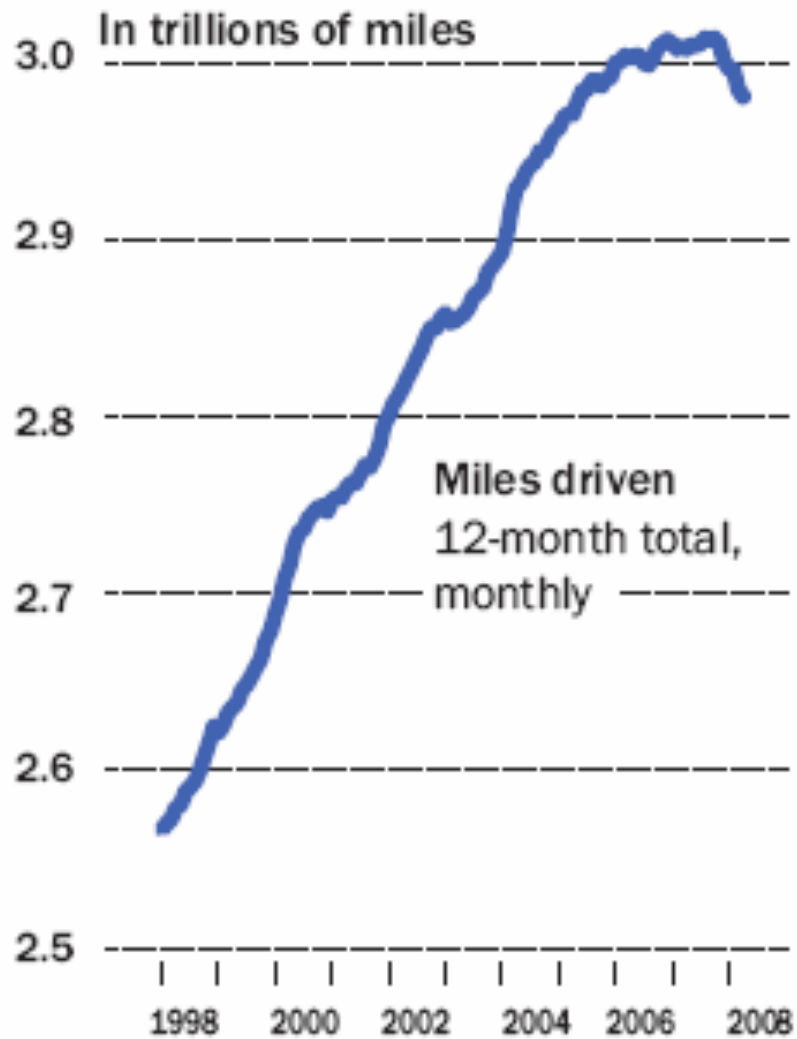
Source: American Physical Society (2008)

US Car and Light Truck Percentage of New Vehicle Sales with Average Price of Gasoline (all grades)



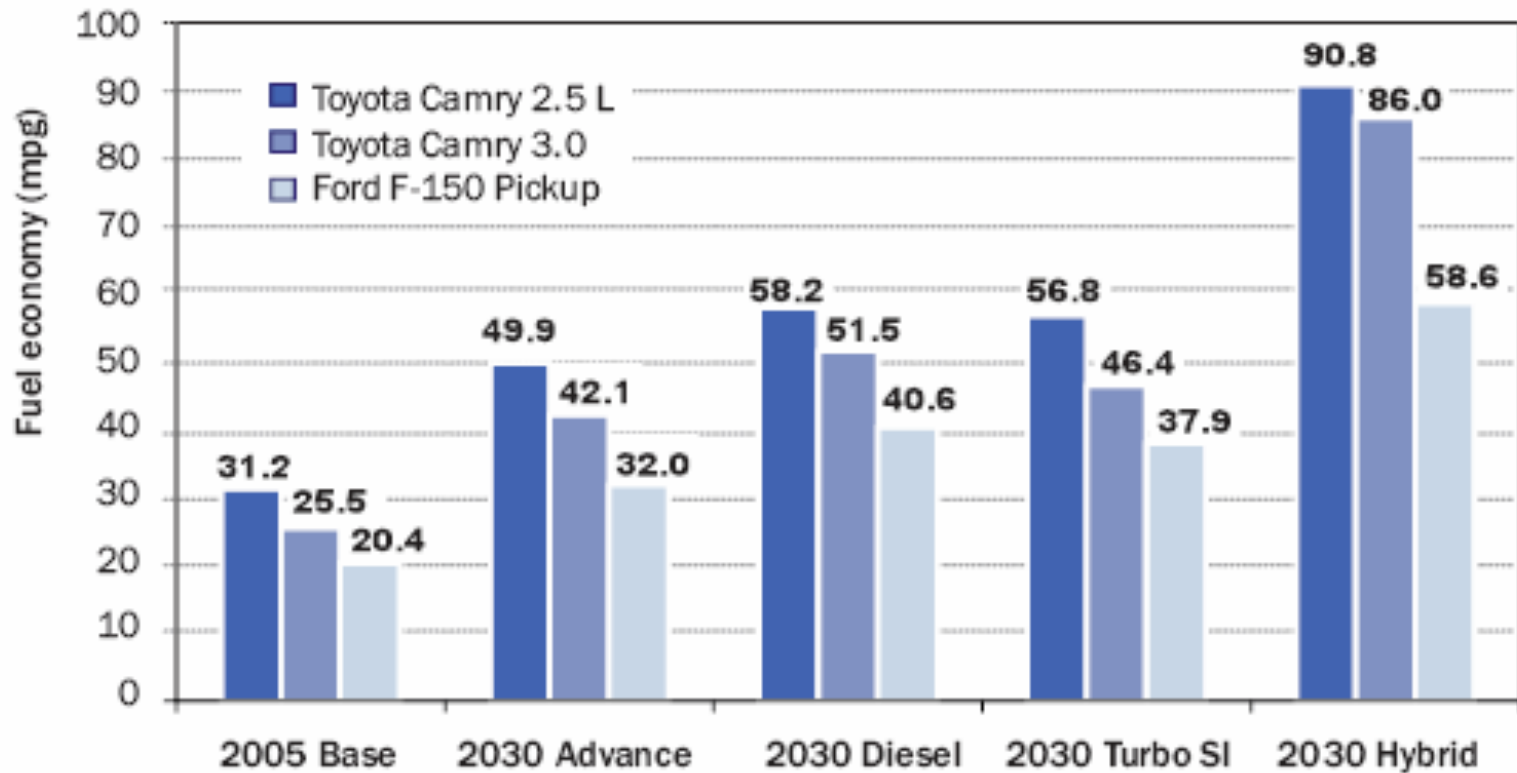
Data: Transportation Energy Data Book, Ed 26-2007, Table 4.6, Autodata and Ward's, EIA

U.S. Vehicle Miles Traveled



Source: American Physical Society (2008)

Technology Advances to Increase Fuel Economy (2030)



Source: American Physical Society (2008)



Opportunities in Other Transportation Modes

- **Heavy Duty Trucks**
 - Truck aerodynamics
 - Fuel injection systems
 - Reduced idling
- **System Level Innovations**

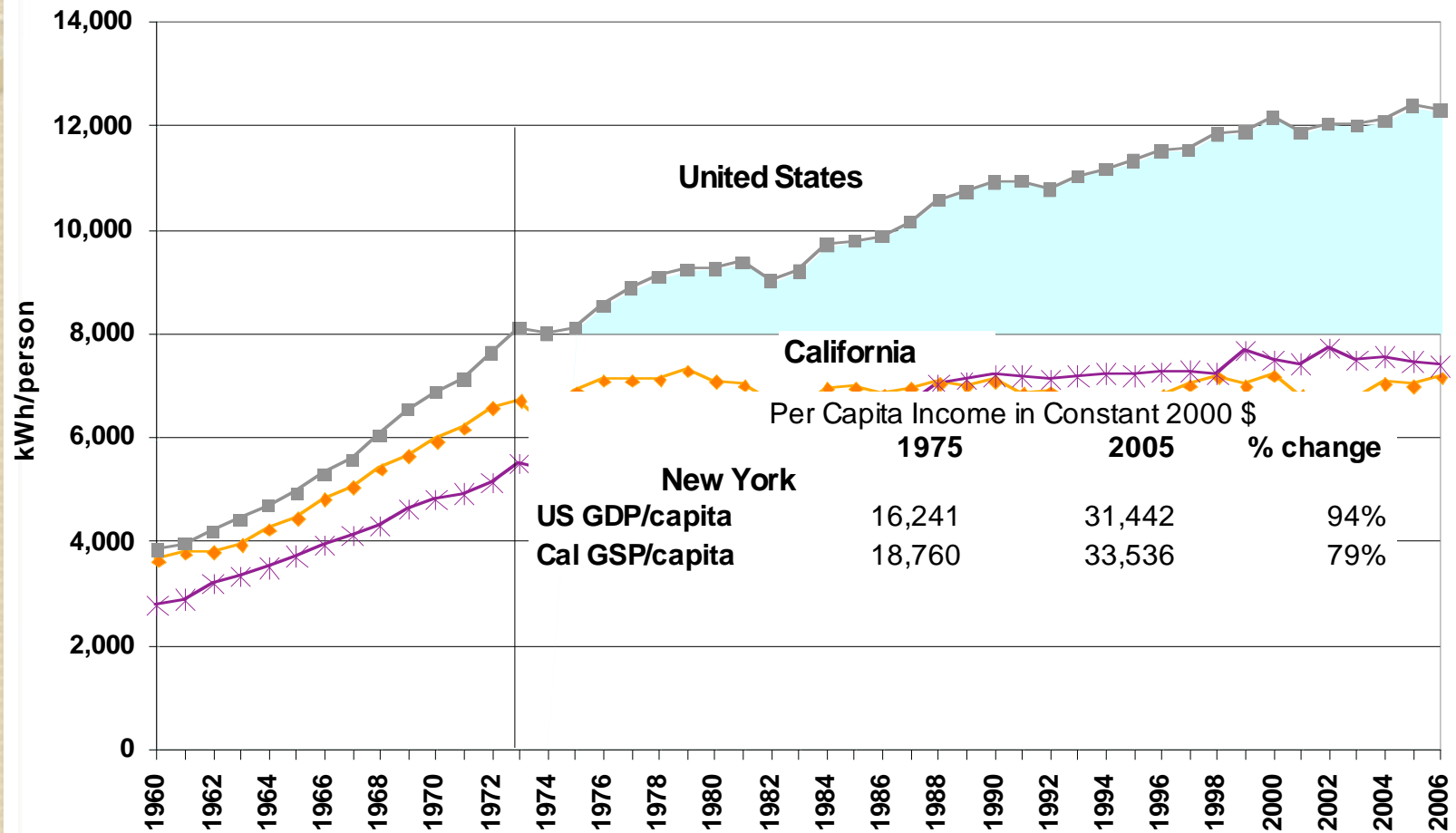



Barriers to Adopting Energy Efficient Technologies

- Price of energy
- Lack of information
- Capital availability
- Fiscal and regulatory policies
- Ownership
- Technical risk
- Human and psychological factors

Per Capita Electricity Consumption in California, New York, and U.S. (1990-2006)

Policies and Programs Can Overcome Barriers



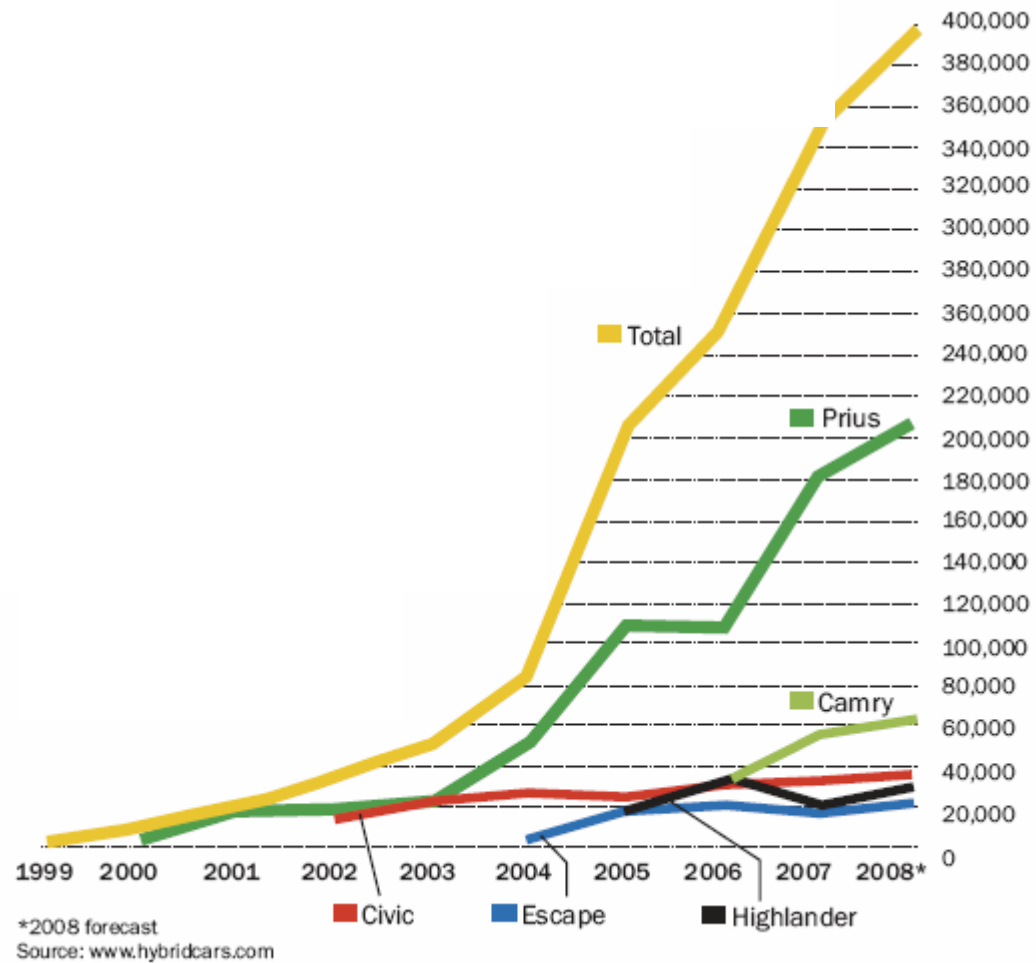


Maximizing energy efficiency and decreasing energy use will remain the lowest hanging fruit for the next several decades. It is something that we should do and we must do.

Steven Chu

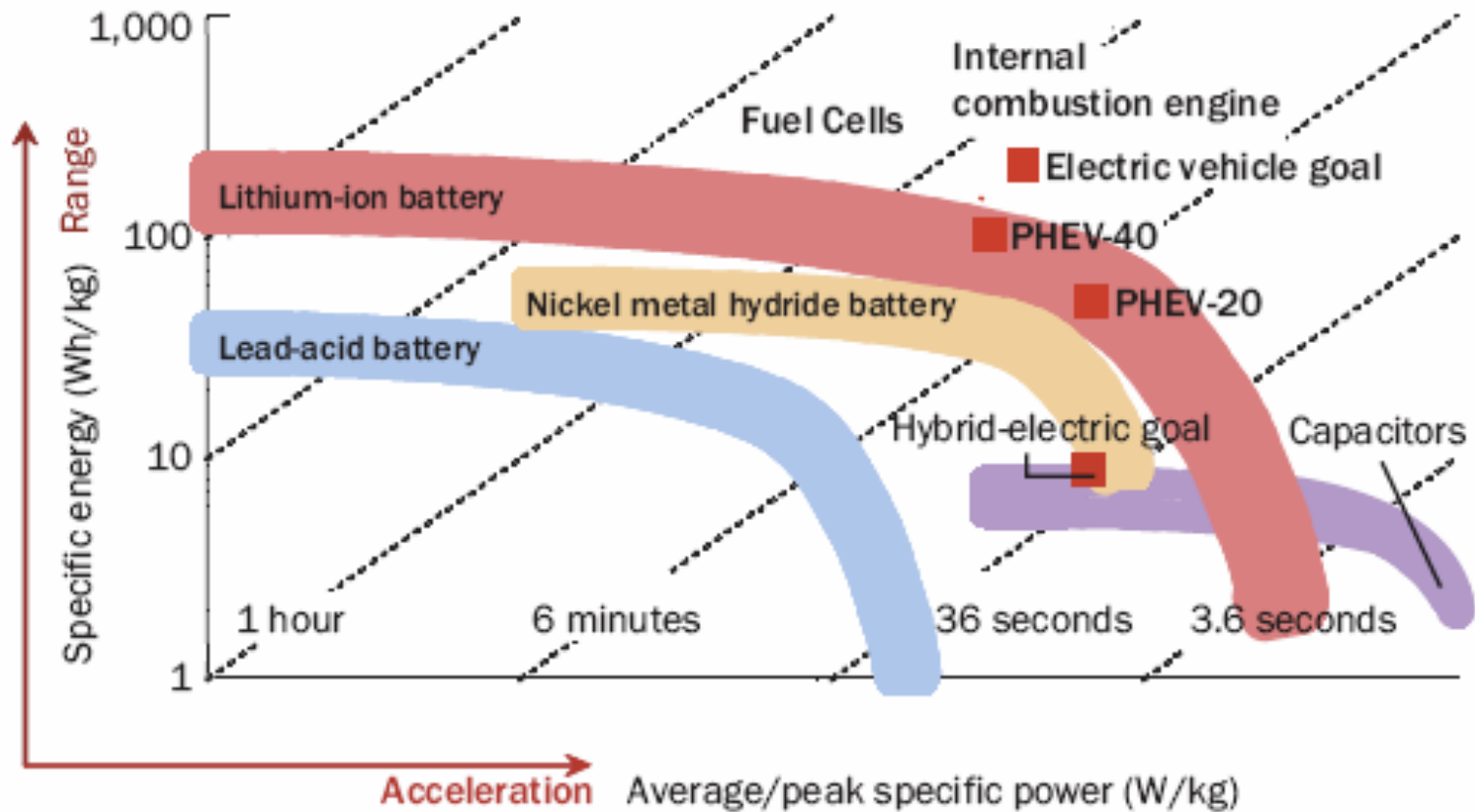
America's Energy Future Summit,
2008

U.S. Hybrid Auto Sales



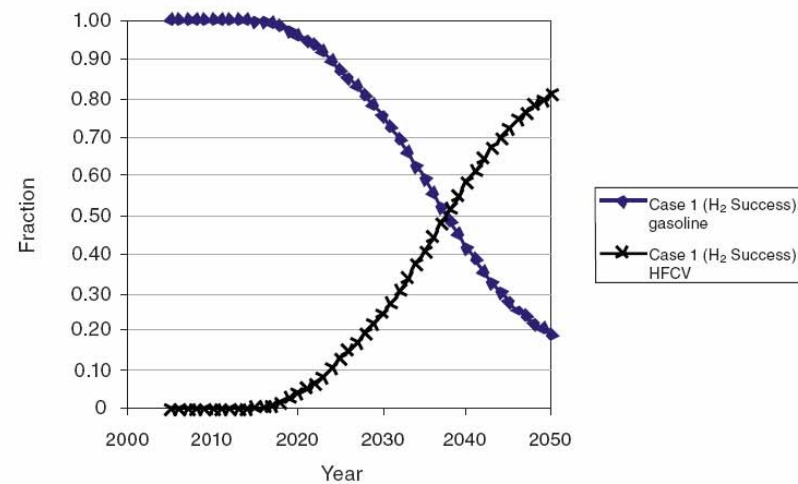
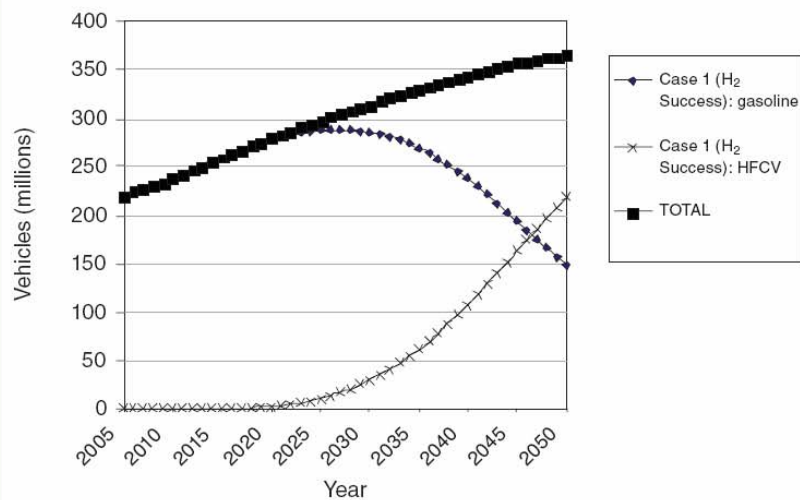
Source: American Physical Society (2008)

Battery Performance



Source: American Physical Society (2008)

Hydrogen Fuel Cell Vehicles (2005-2050)



Source: National Research Council (2008)