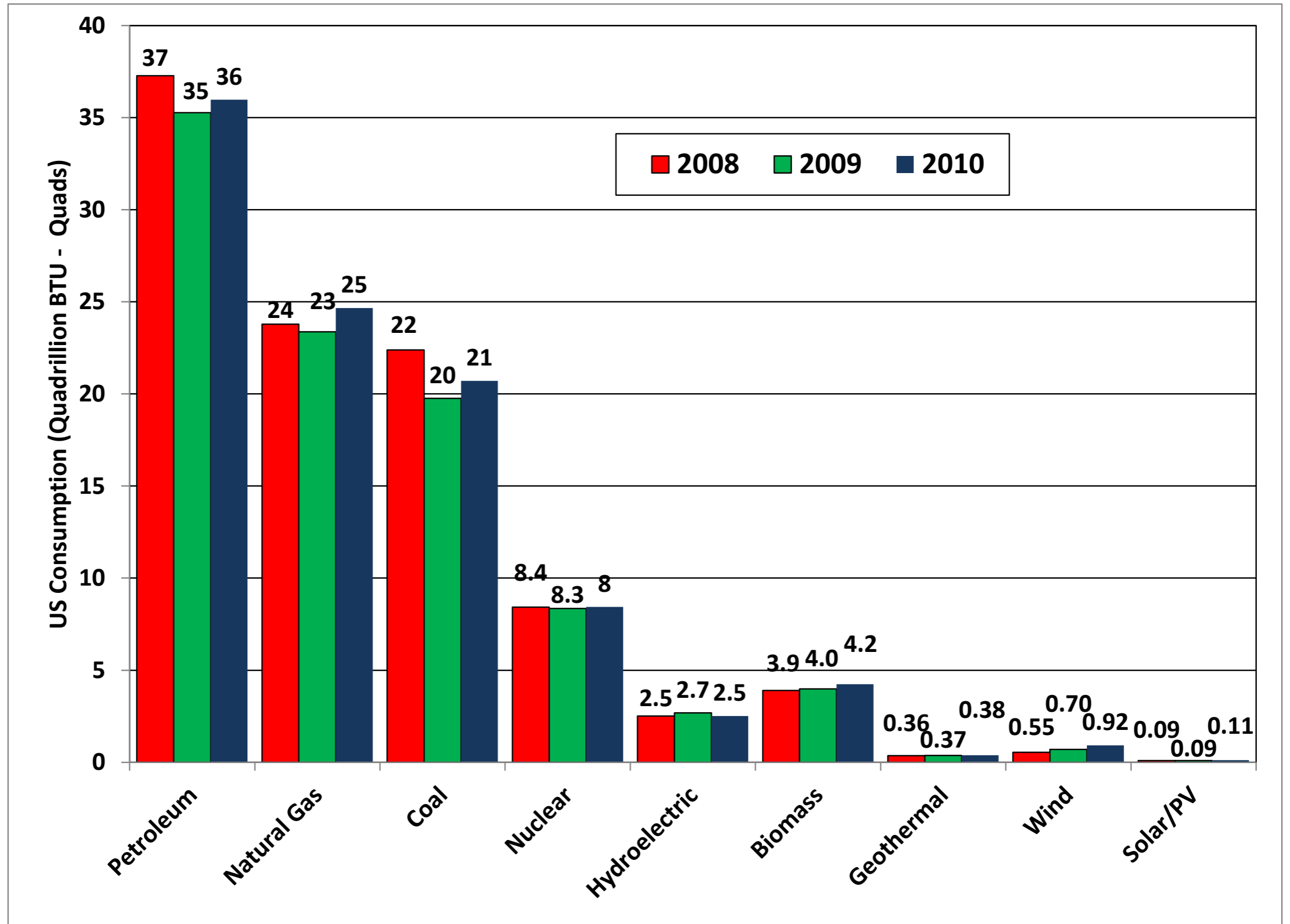
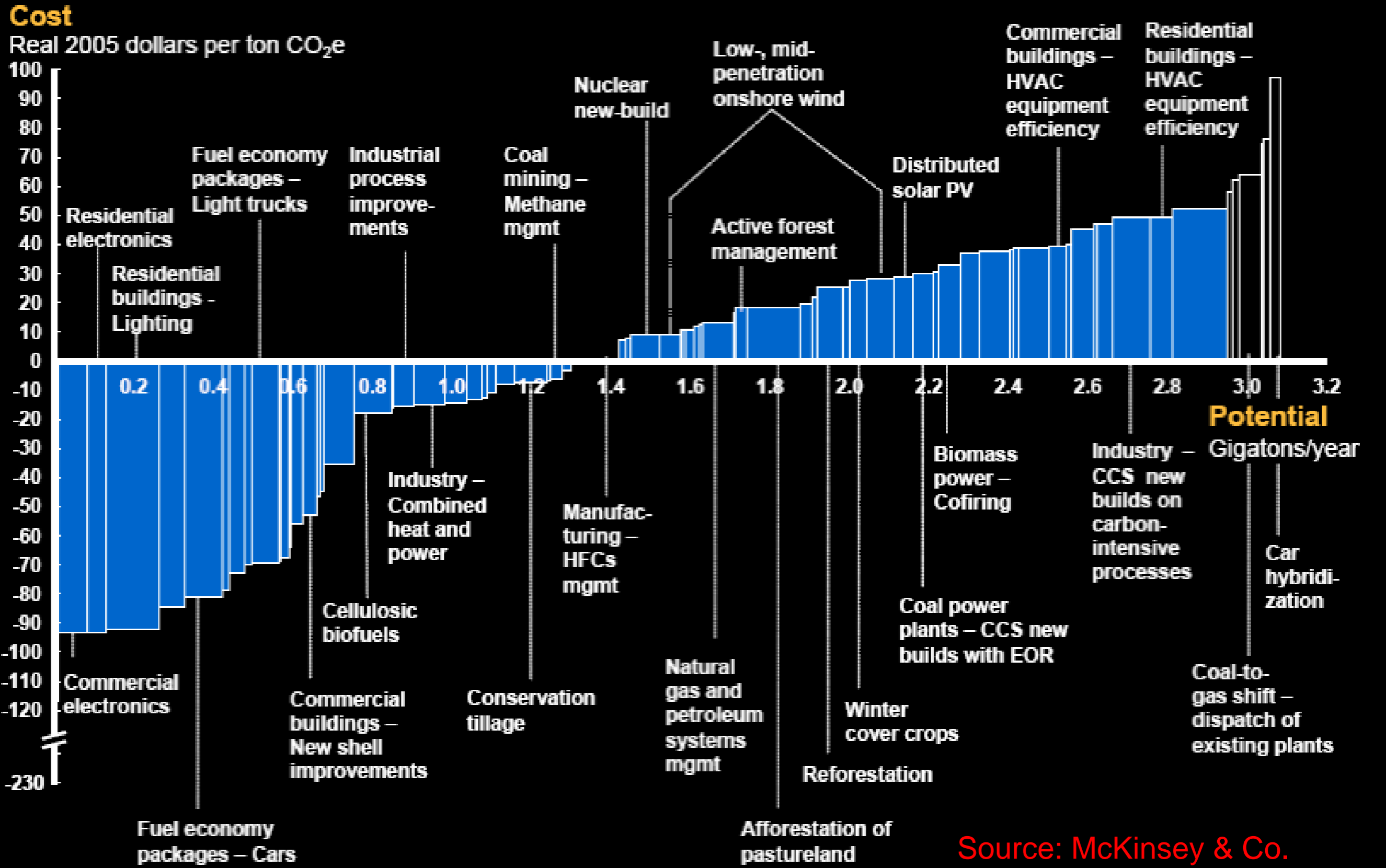


# US Energy Use



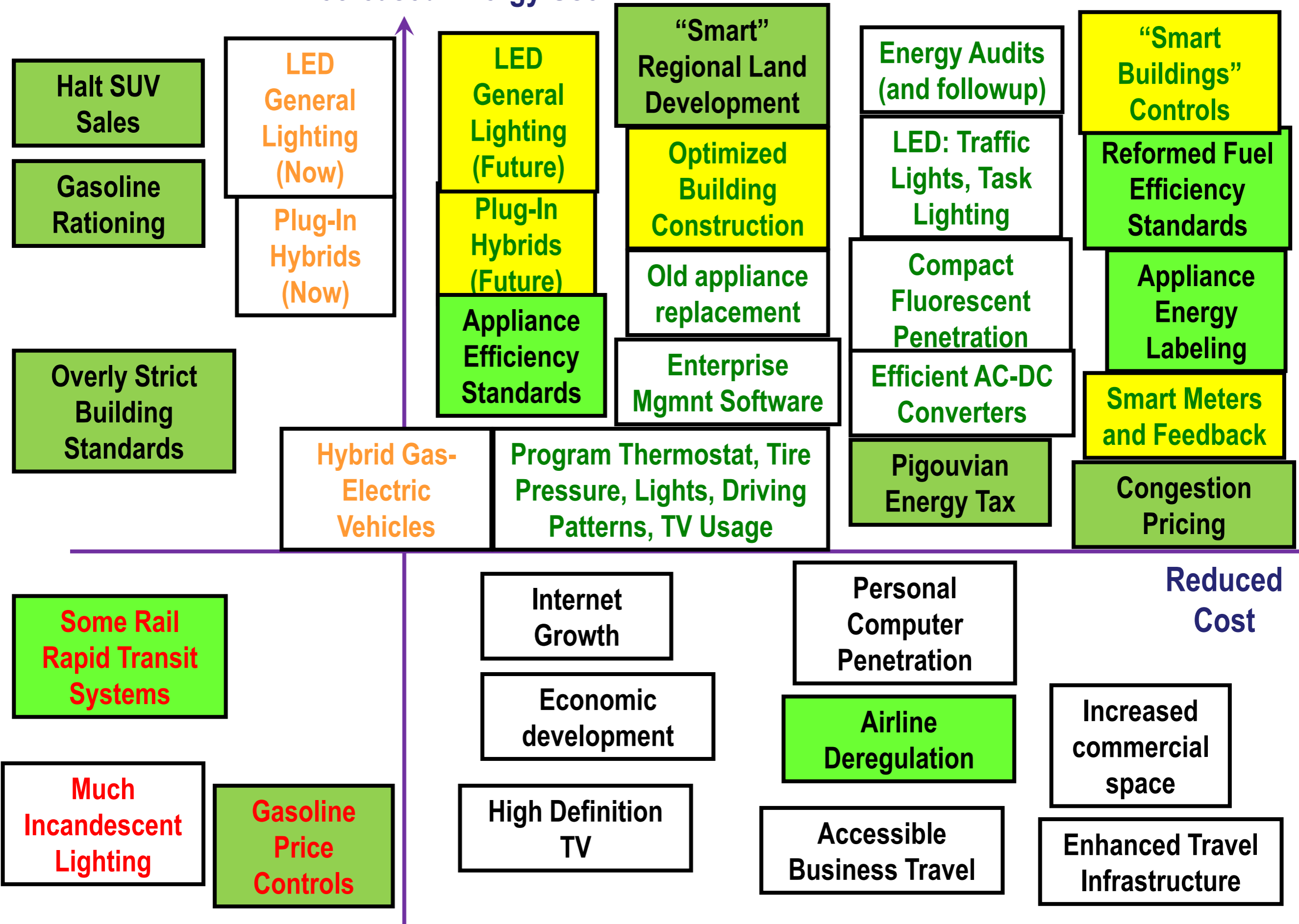
# GHG reduction opportunities widely distributed – 2030 mid-range case

Abatement costs <\$50/ton



Source: McKinsey & Co.

# Decreased Energy Use



# Barriers to Optimality

Institutional Barriers	Market failures	Behavioral Issues
	<b>Externalities: Usage; R&amp;D</b>	<b>Low salience of energy issues ???</b>
<b>Structure of crafts for building construction</b>	<b>Principal/Agent Problems</b>	<b>Principal/Agent Problems</b>
<b>Limited modeling tools for building design</b>	<b>Poor Information about Prices and Energy Use</b>	<b>Poor Information about Prices and Energy Use</b>
<b>Organization of Corporations</b>	<b>Incomplete markets for energy efficiency</b>	<b>Managerial Priorities</b>
	<b>Systems Issues (E.g. Chicken &amp; Egg)</b>	<b>Lack of Energy-Related Information Systems</b>
<b>Distortionary regulatory and fiscal policies</b>		<b>Cognitive Skills</b>

# Total US Expenditures on Energy Consumption (2007): \$1.233 Trillion

**(About 9% of GDP)**

Billions

\$600

\$500

\$400

\$300

\$200

\$100

\$0

■ Retail Electricity

■ Biomass

■ Petroleum

■ Natural Gas

■ Coal

2007 US GDP:

\$14 Trillion

2007 Disposable Personal Income

\$10.4 Trillion

**About 2.3% of  
DPI**

**About  
5.6%  
of DPI**

Residential

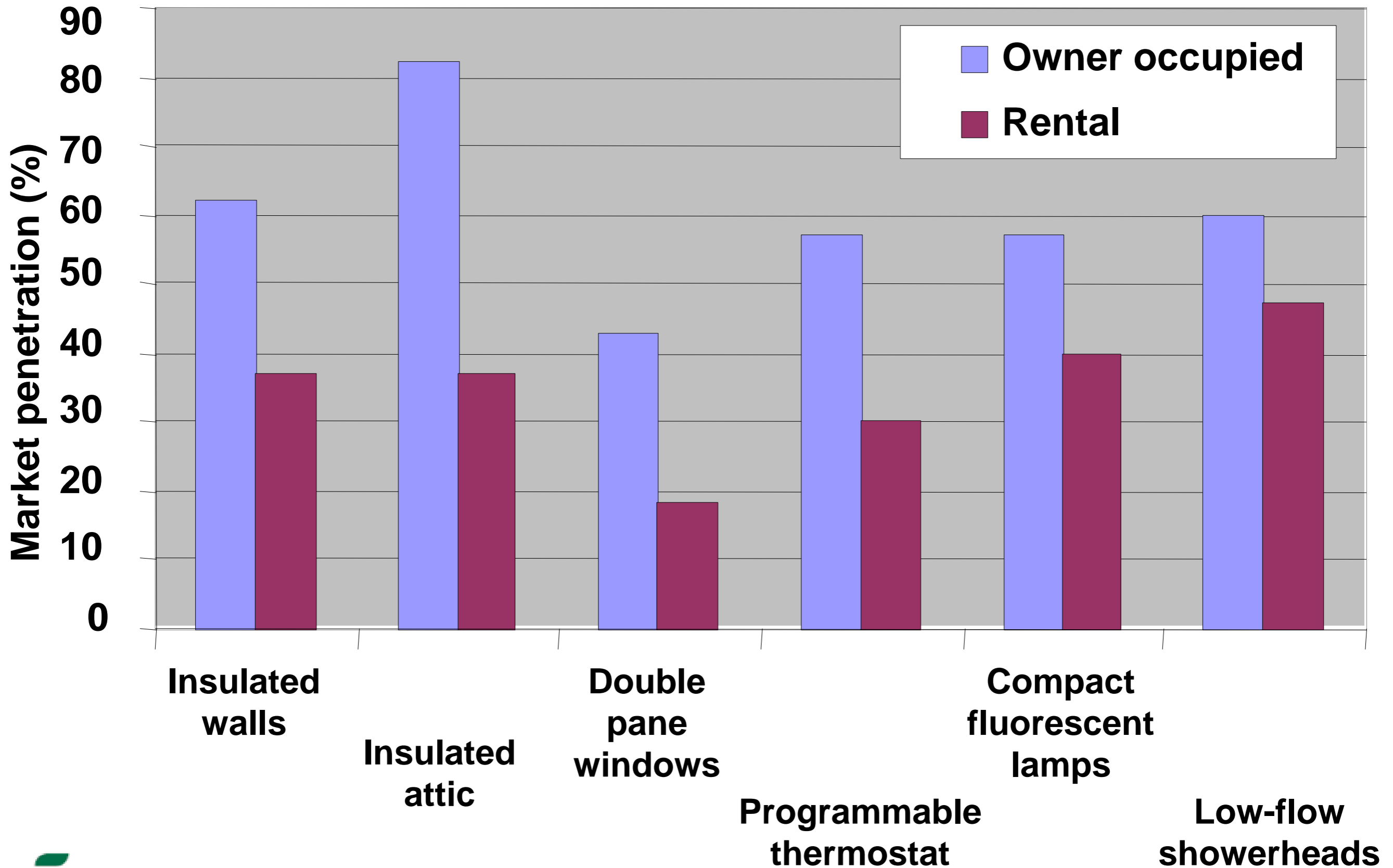
Commercial

Industrial

Transportation

Electricity includes non-primary energy costs of electric system

# Market Penetration of Energy Efficiency Measures in Owner-Occupied and Rental Housing in California (CEC 2004)





*"It runs on its conventional gasoline-powered engine until it senses guilt, at which point it switches over to battery power."*

# Some Motivational Approaches

- **Pricing**

- **A carbon price would have pervasive effects on energy use in all sectors**
- **However, carbon prices will not address many of the market failures nor the information and cognitive issues**
- **Navy experiment with base housing: benchmarks and charges or payments for deviations in energy use from the benchmarks**
- **Gasoline taxes in Europe vs US motivate purchase of smaller more fuel efficient vehicles**



# Some Motivational Approaches

- **Information**
  - **Labeling; e.g. Energy Star**
  - **Building performance rating and rating disclosure.**
    - **E.g., California mandatory building ratings**
  - **Easily processed economic data**
- **Information systems**
  - **New genre of enterprise-wide energy and carbon accounting and management software.**
  - **E.g., C3, Hara. Make it less costly to find energy efficiency options in large distributed organization, allow central management of energy and carbon savings, allow alignment of incentives with management energy goals**

# Other Motivational Approaches

- **Feedback (immediate information linked to decisions)**
  - **Smart meters, sensors, energy information appliances**
  - **Google/Stanford experiment with Google Powermeter**
  - **Three levels of possible feedback**
    - **Consumer use of appliance/technology**
    - **Consumer purchase of appliance/technology**
    - **Manufacturer supply of appliance technology**

# Other Motivational Approaches

- **Stochastic Rewards**
  - **Balaji Prabhakar congestion experiment with Infosys in Bangalore, India**
  - **Goal: incentives for Infosys commuters to travel at uncongested times**
  - **Infosys employees given chance for one month extra salary each time they took bus to arrive one half hour earlier than rush hour, two chances for arriving one hour earlier.**
    - **Expected value per ticket was 20 rupees – 10 cents.**
    - **Roughly 15% of employees decided to come one-half hour or one hour early.**

# Other Motivational Approaches

- **Social norms**
  - **Billing information that compares electricity use to neighbors or other norms. E.g. OPower mailings.**
  - **Navy housing experiments mentioned in last slide**