

Energy Efficiency

Henry Kelly, President

Federation of American Scientists

**Conference on Bridging the Gap
Between Science and Society**

1-2 November 2003

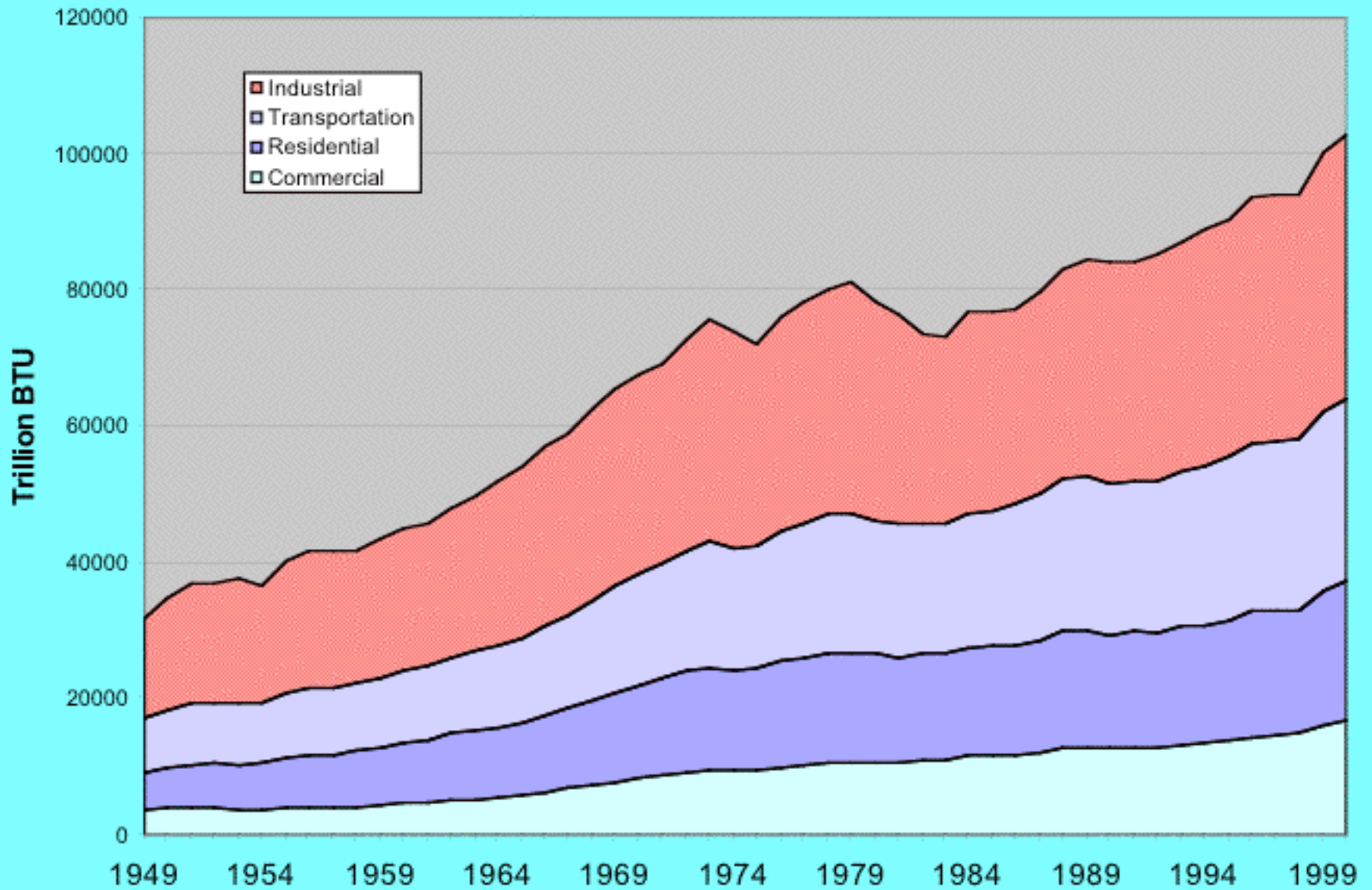
RICE UNIVERSITY

Energy Productivity

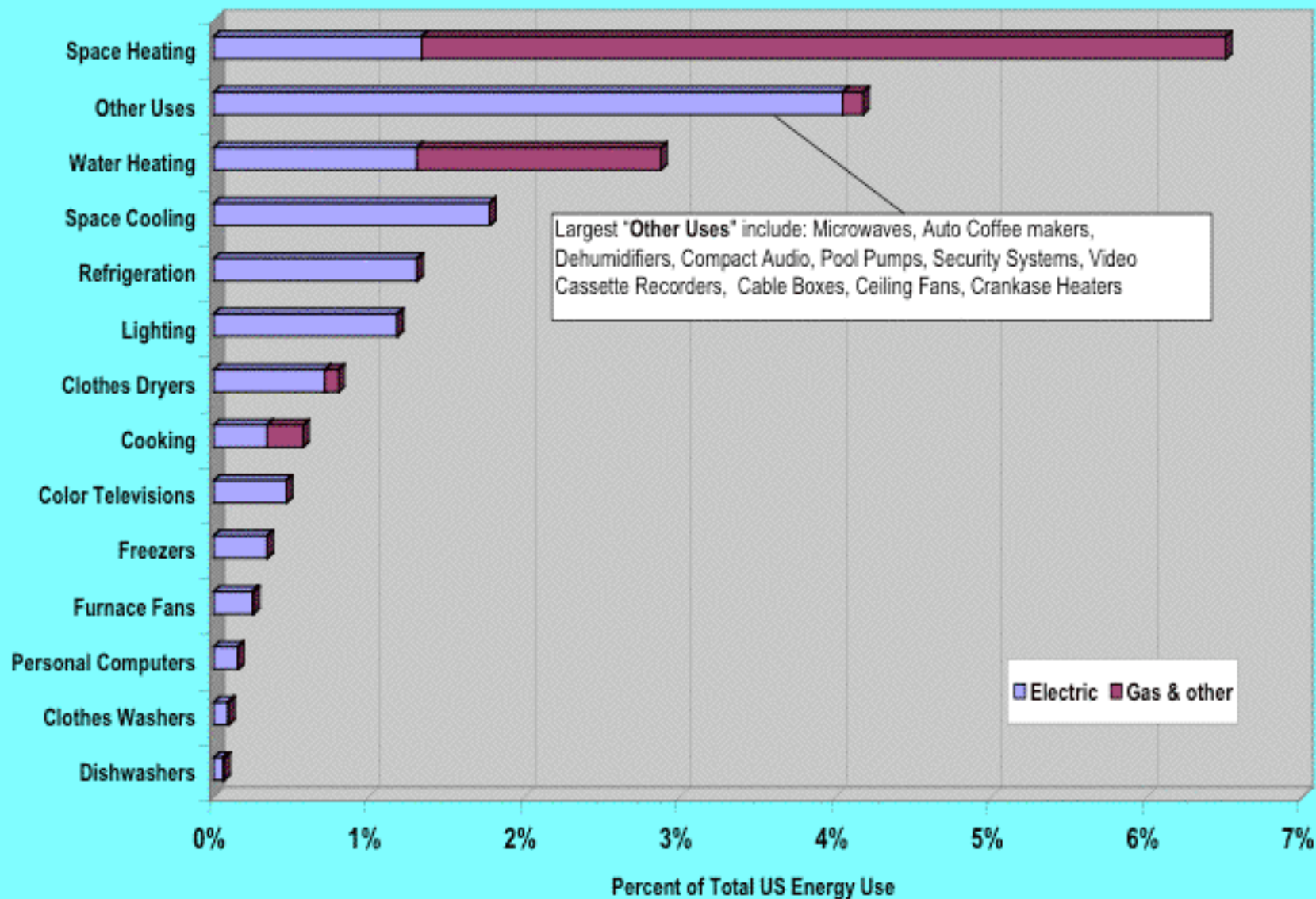
Economic Output =

**Function of (*Capital, Labor, Services,*
Energy)**

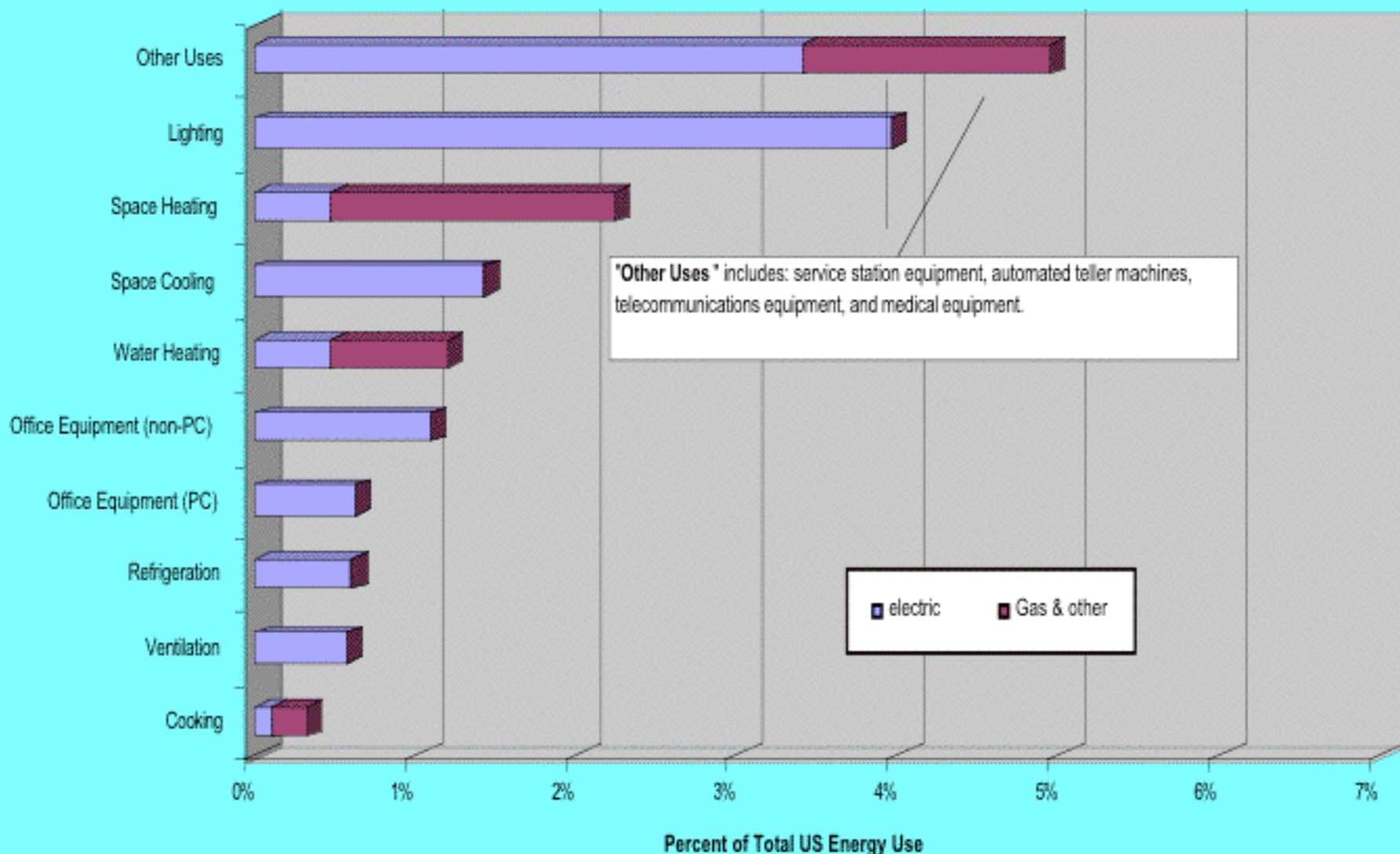
Total US Energy Use



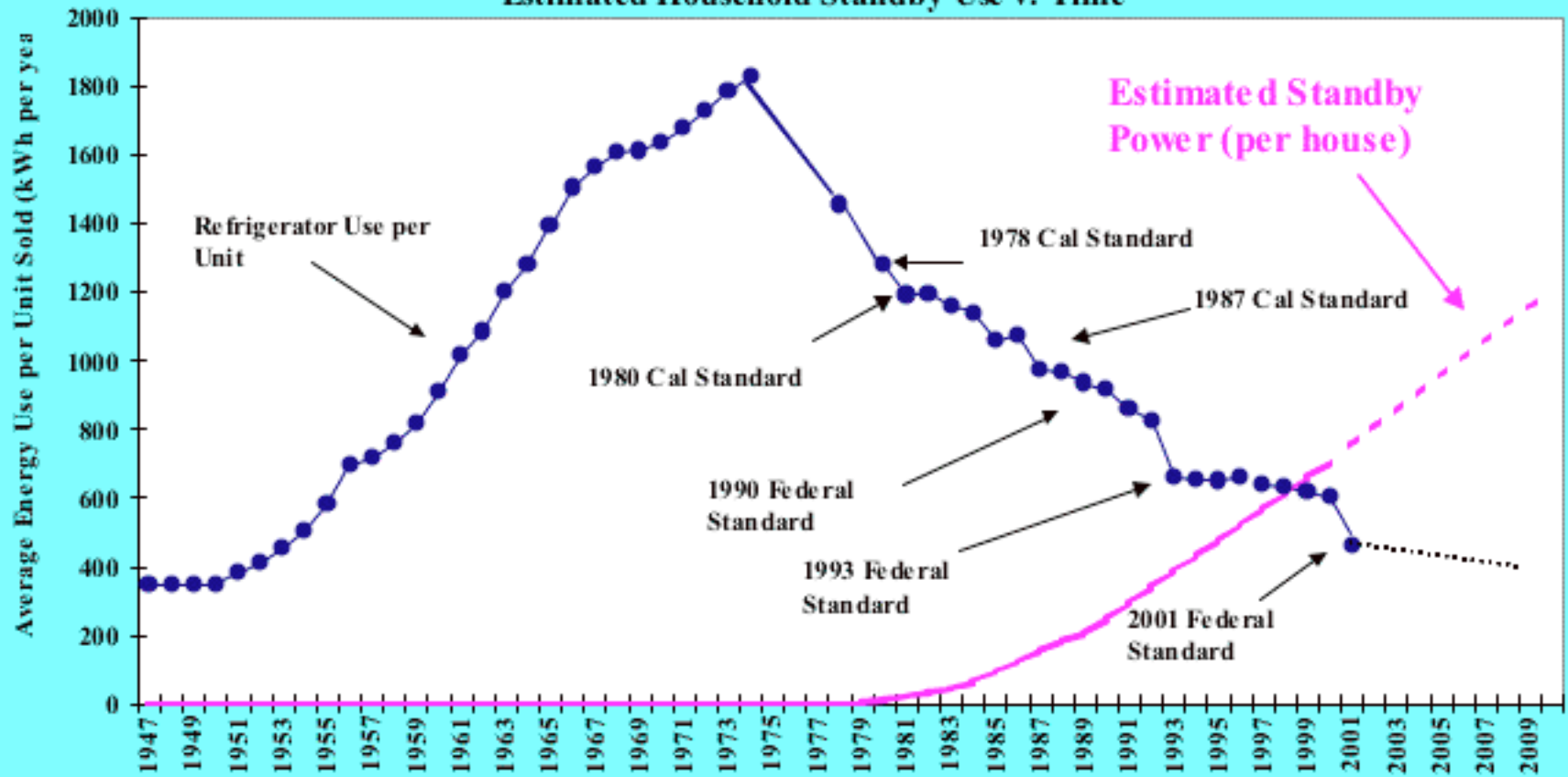
Residential Energy Use in 2002



Commercial Energy Use in 2002

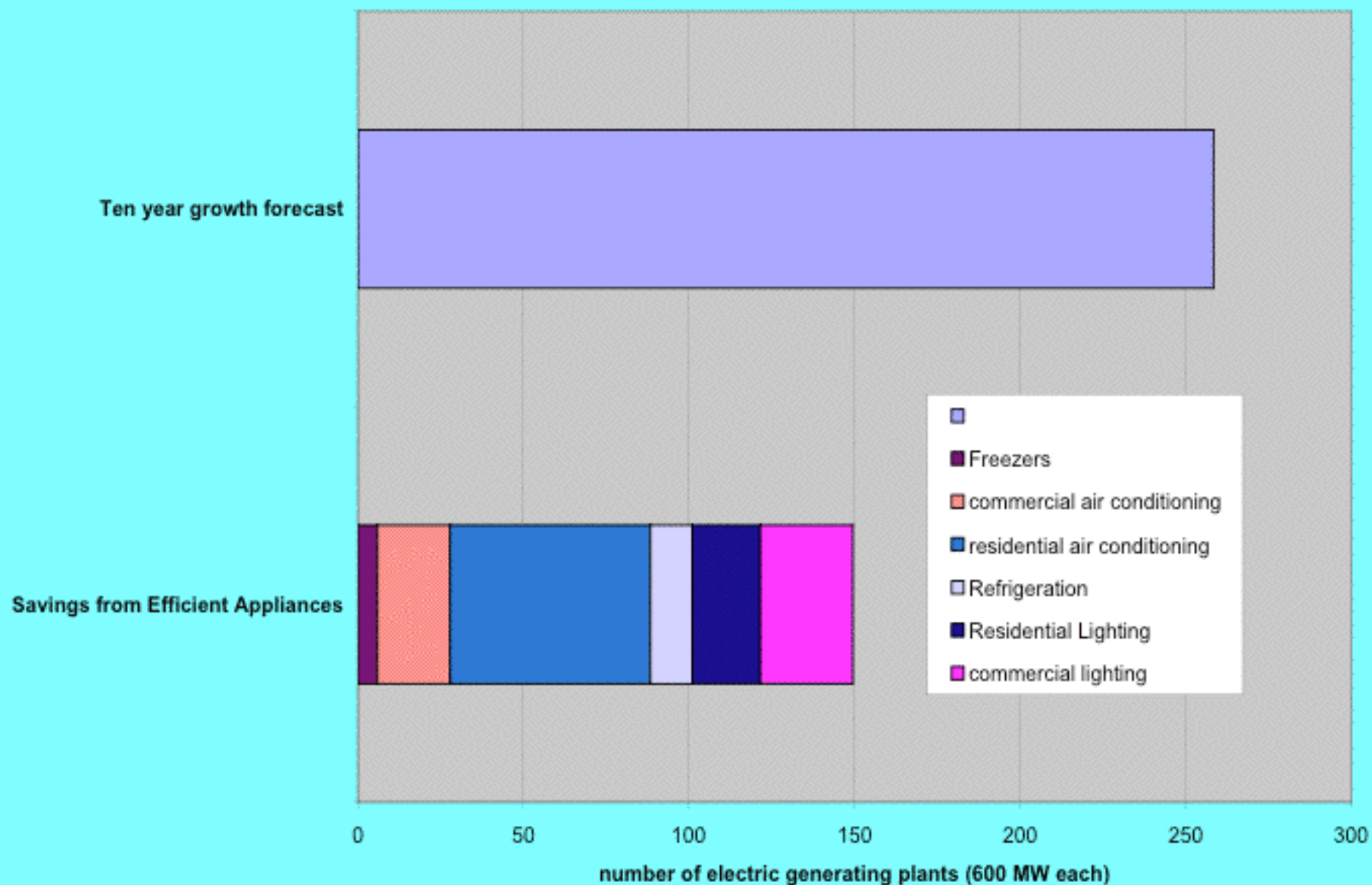


United States Refrigerator Use (Actual) and Estimated Household Standby Use v. Time



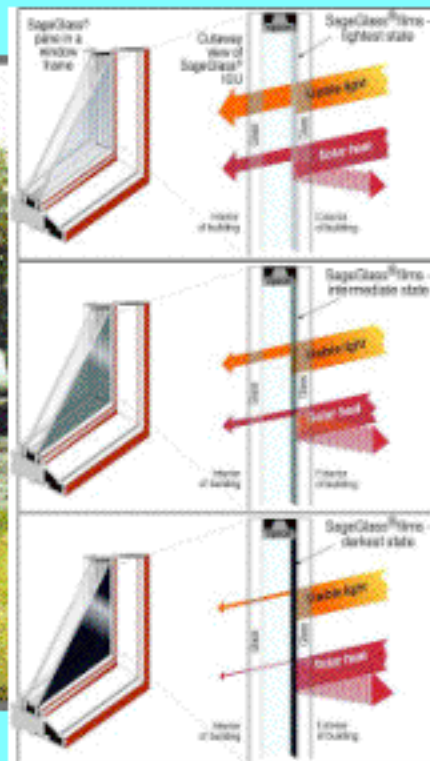
Source: Geller & Goldstein & CEC/Rosenfeld

Appliance savings vs 10 year growth in electric demand



The Ideal Window

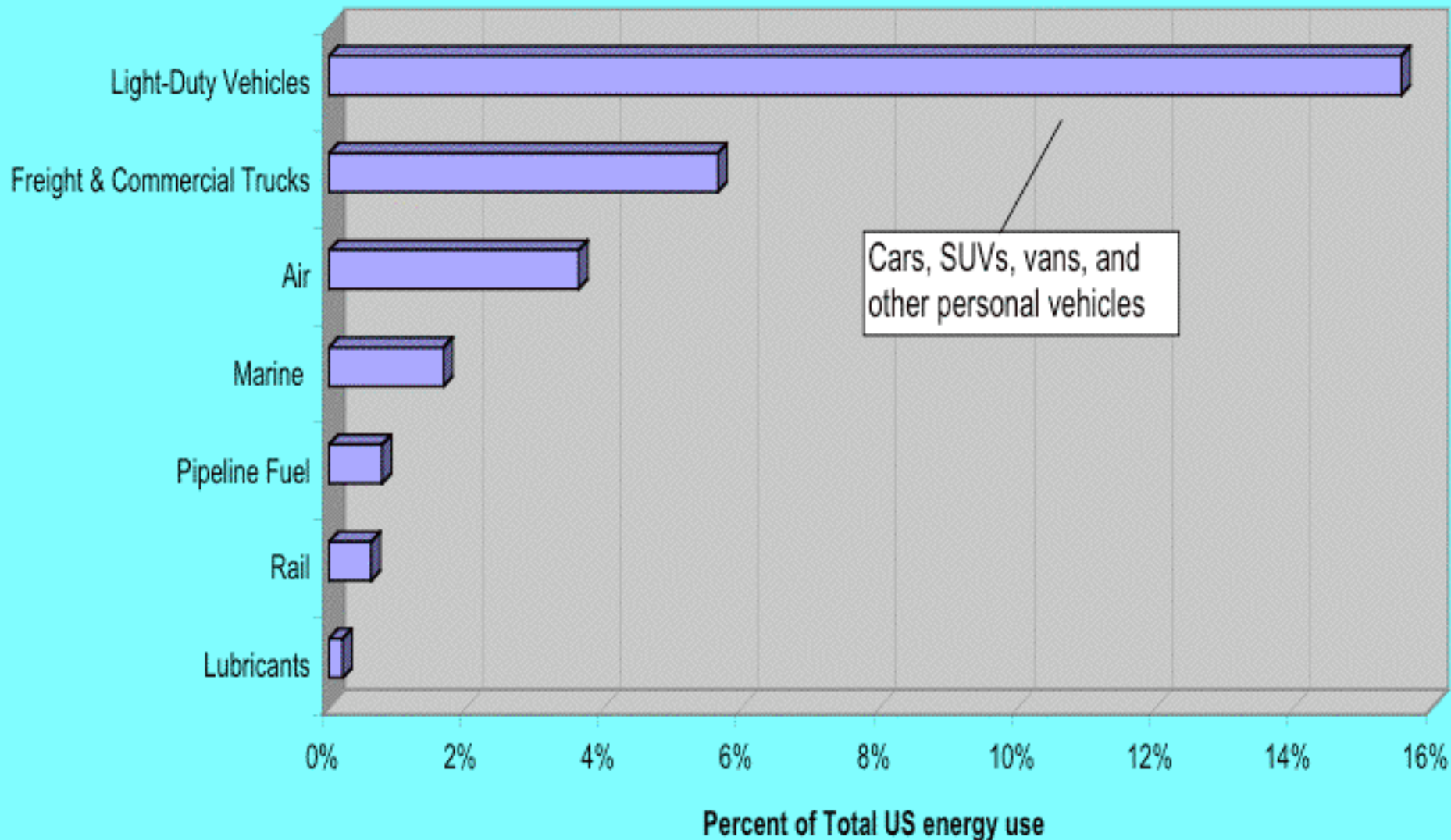
- Controllable emissivity
- Controllable transmissivity (visible, IR)
- Convert non-transmitted energy to electricity
- Control air transport/ventilation
- Resist penetration during strong winds
- Produces light on demand
- Patterns/images?
- stable over range of temperatures, no color distortion, reacts quickly, easily dispatched



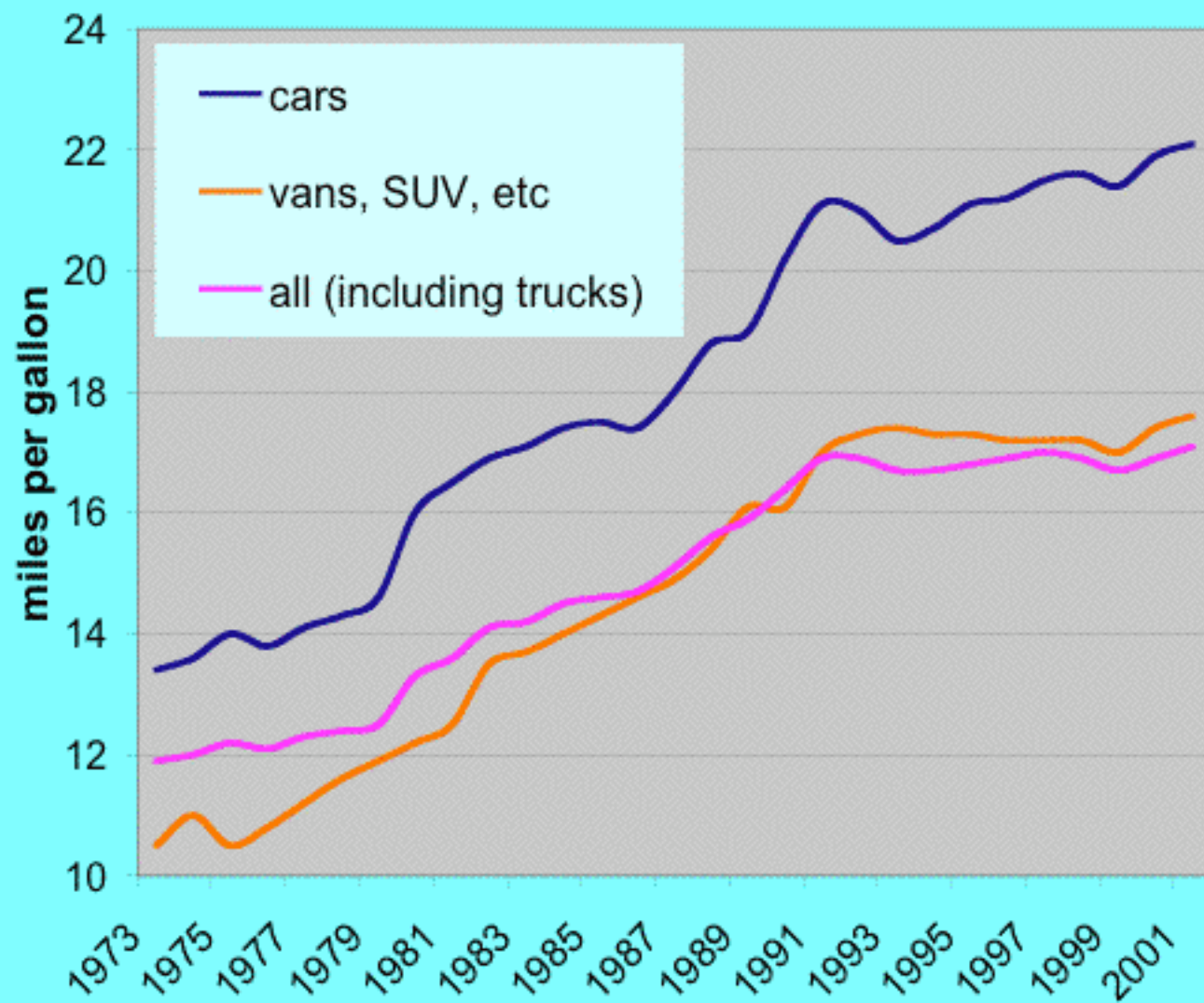
The Ideal Building Shell

- Attractive, versatile
- Inexpensive to build AND maintain
- Safe in high wind, earthquakes
- Resists mold, termites
- Excellent thermal properties

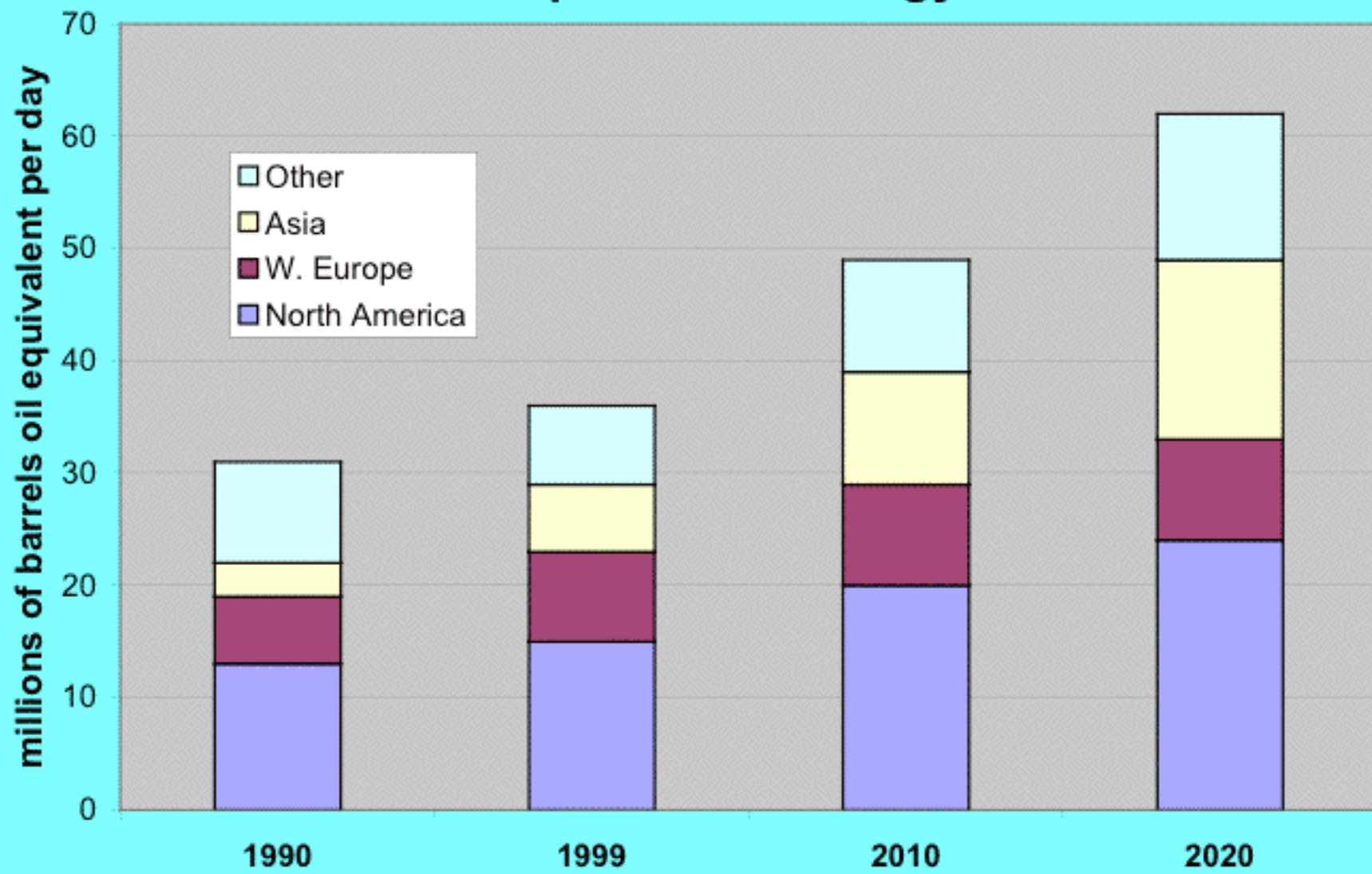
Transportation Energy Use in 2002



Vehicle Fuel Economy

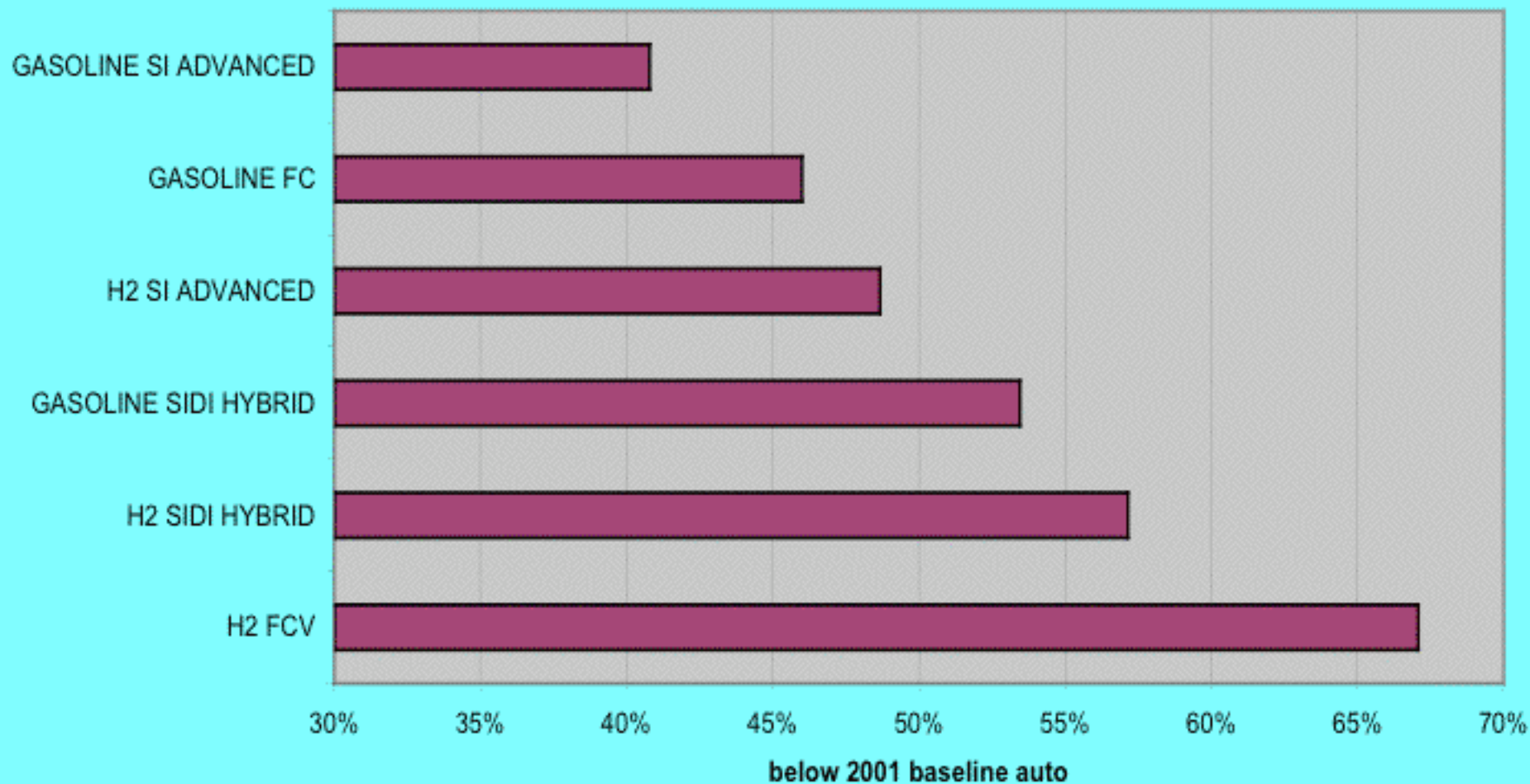


Transportation Energy Use



Net Energy Use Reductions

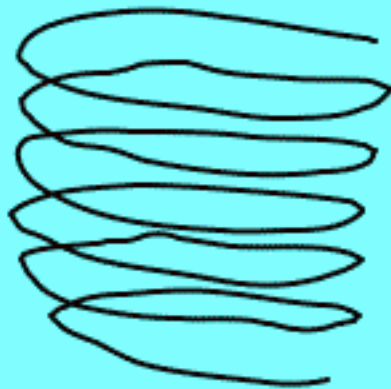
(efficiencies include energy lost in producing fuel, transmission losses, embodied energy)



Ideal Energy Storage

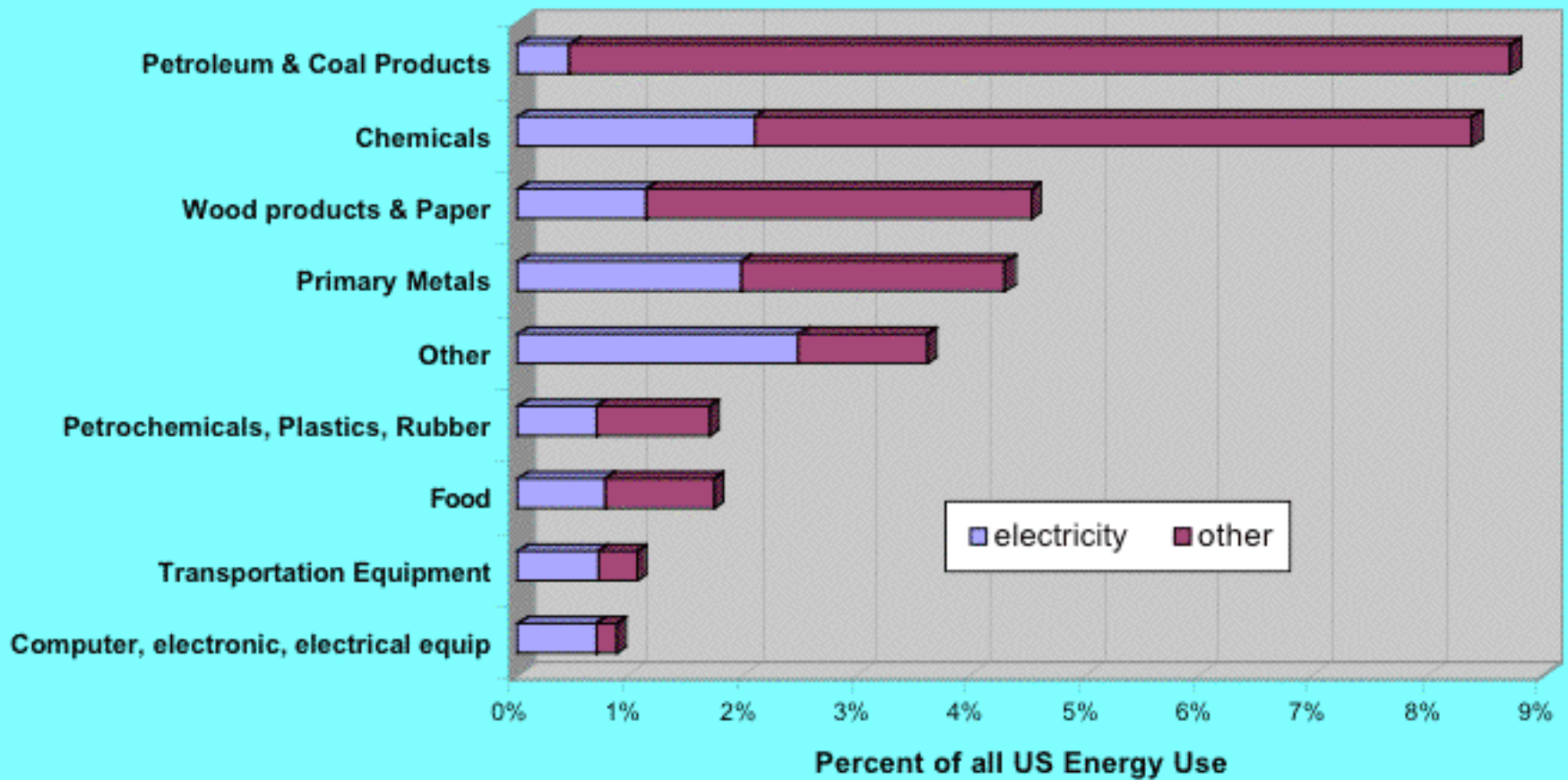


- onboard fuel (safe, portable, lightweight, conform to vehicle design space)



- recover braking energy (80% + recovery ,fast charge and discharge)

Industry Energy Use in 2002

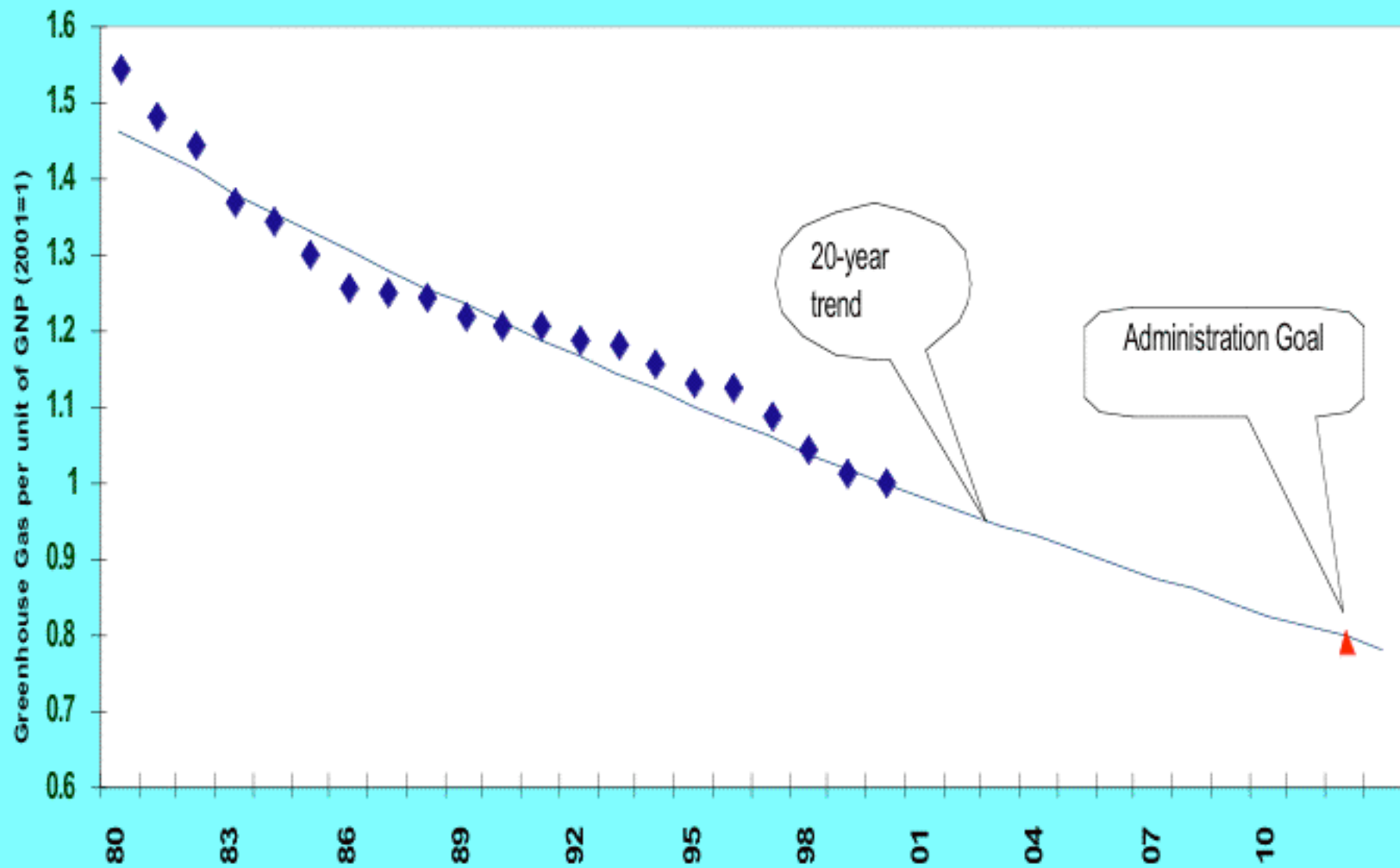


Next Generation Manufacturing

- On-demand assembly of complex objects
- Assembly of complex materials starting with widely available, and/or renewable materials
- biodegradable waste



US Green House Gas Production per unit of GNP



The Politics of this Issue Is Ridiculous!

- Who is opposed to productivity?
- Biotechnology, information science, new materials drive productivities including energy productivity
- Private investment in invention in energy
Productivity may be low because energy prices don't reflect full social value
- Careful public investment in innovation is critical

So tell me again, what are we arguing about?