Energy Efficiency

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Energy Productivity

Economic Output = Function of (Capital, Labor, Services, Energy)
Residential Energy Use in 2002

Largest "Other Uses" include: Microwaves, Auto Coffee makers, Dehumidifiers, Compact Audio, Pool Pumps, Security Systems, Video Cassette Recorders, Cable Boxes, Ceiling Fans, Crankase Heaters
Commercial Energy Use in 2002

*Other Uses* includes: service station equipment, automated teller machines, telecommunications equipment, and medical equipment.
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

Ten year growth forecast

Savings from Efficient Appliances

- Freezers
- Commercial air conditioning
- Residential air conditioning
- Refrigeration
- Residential lighting
- Commercial lighting

number of electric generating plants (600 MW each)
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

- Light-Duty Vehicles
- Freight & Commercial Trucks
- Air
- Marine
- Pipeline Fuel
- Rail
- Lubricants

Cars, SUVs, vans, and other personal vehicles

Percent of Total US energy use
Vehicle Fuel Economy

- cars
- vans, SUV, etc
- all (including trucks)

Y-axis: miles per gallon
X-axis: years from 1973 to 2001
Net Energy Use Reductions
(efficiencies include energy lost in producing fuel, transmission losses, embodied energy)

- GASOLINE SI ADVANCED
- GASOLINE FC
- H2 SI ADVANCED
- GASOLINE SIDI HYBRID
- H2 SIDI HYBRID
- H2 FCV

below 2001 baseline auto

SOURCE: Ogden et al 2003
Ideal Energy Storage

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

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

20-year trend

Administration Goal

Source: DOE/EIA
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?