

# Federal Energy Policy: Will it Get Us “From Here to There”?

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# Today's Focus

- ✱ **Global energy challenges**
- ✱ **How federal energy policy and funding tracks energy challenges**
- ✱ **Technology roads not chosen**



# Today's Focus

## Global energy challenges

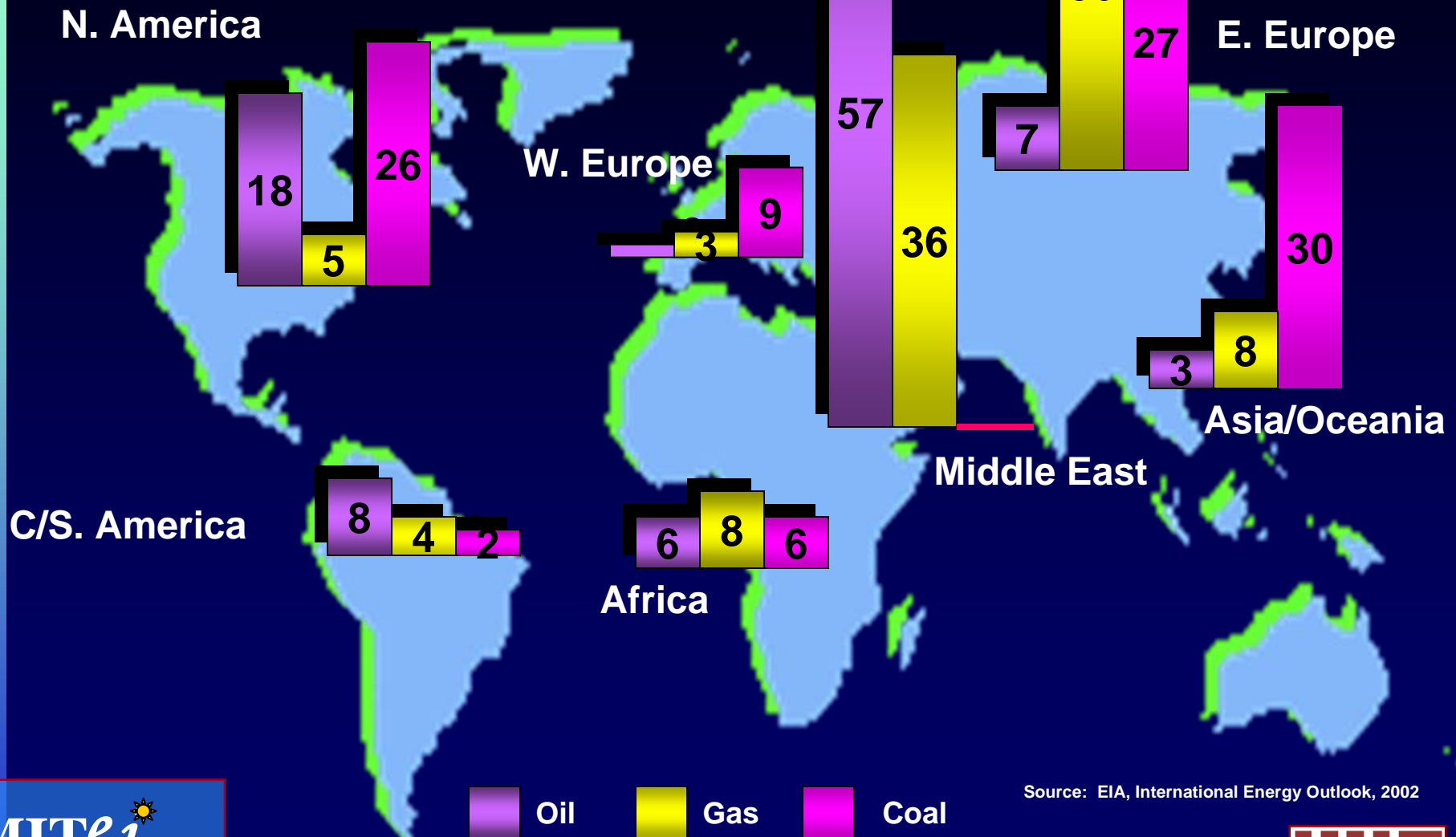


# Energy Challenges (in short)

- ☀ **Increased Energy Demand**
  - ☀ **Climate Change**
  - ☀ **Energy Security**
- **plus** --
  - ☀ **Scale**
  - ☀ **Urgency**



# % Oil/Gas/Coal Reserves By Region

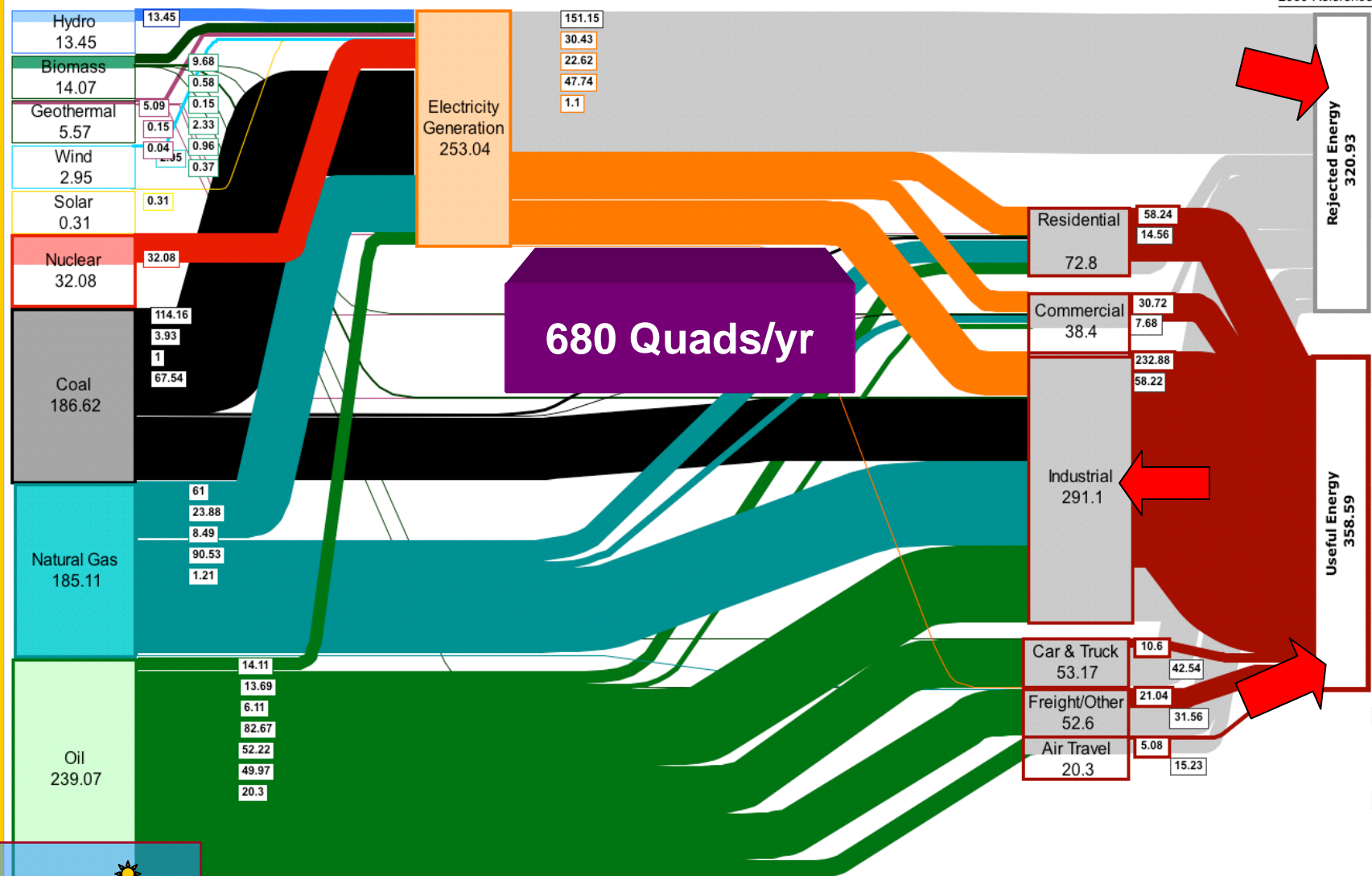


Source: EIA, International Energy Outlook, 2002



# Global Energy Consumption 2030

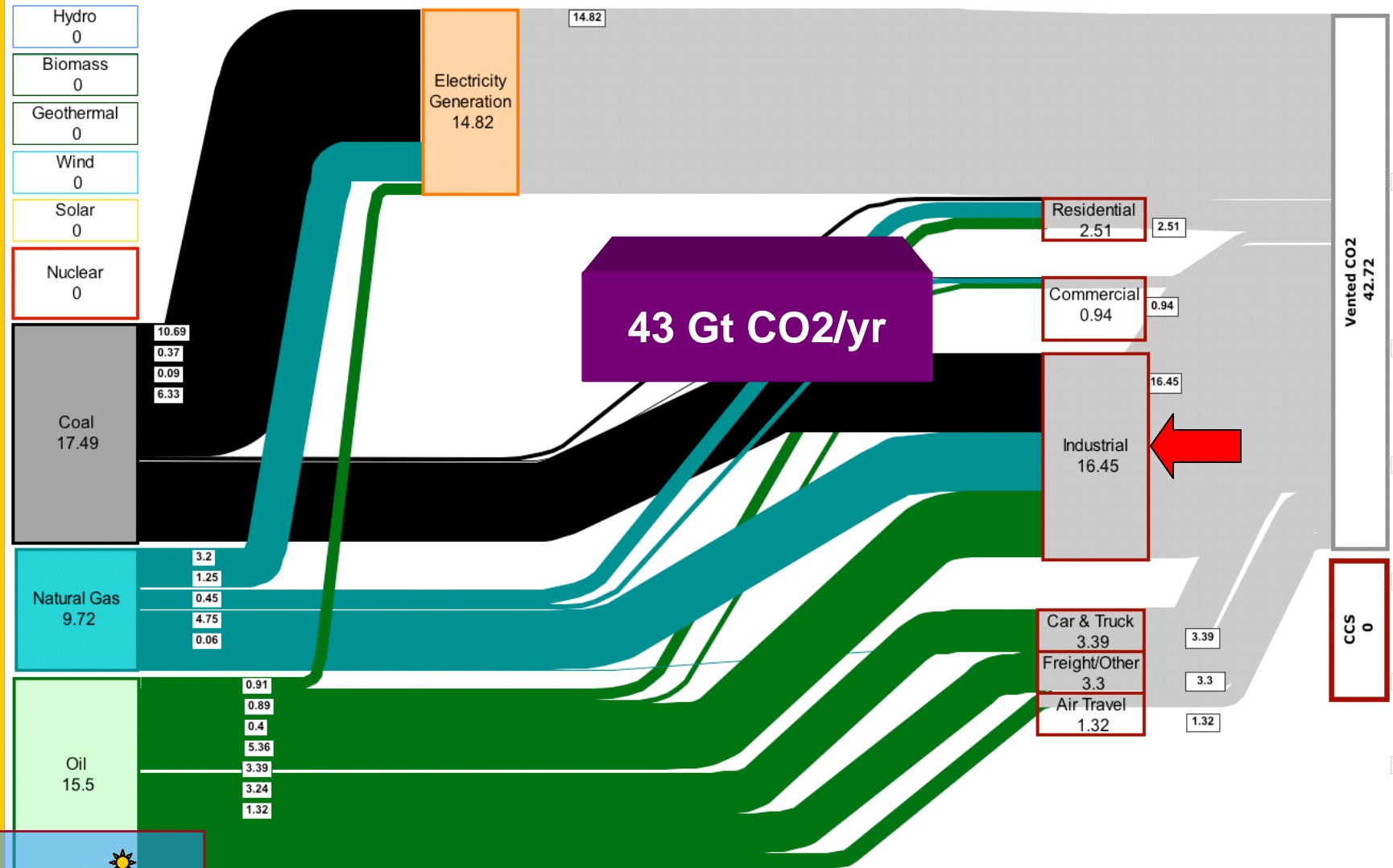
Estimated Future Energy Flows ( $\approx 679.5$  Quads/Year)



# CO<sub>2</sub> Emissions 2030

Estimated Carbon Dioxide Flows: CCS = 0 Vented = 42.72 [Gt CO<sub>2</sub>/Year]

World  
2030 Reference



Source: Lawrence Livermore National Laboratory, John Ziegas



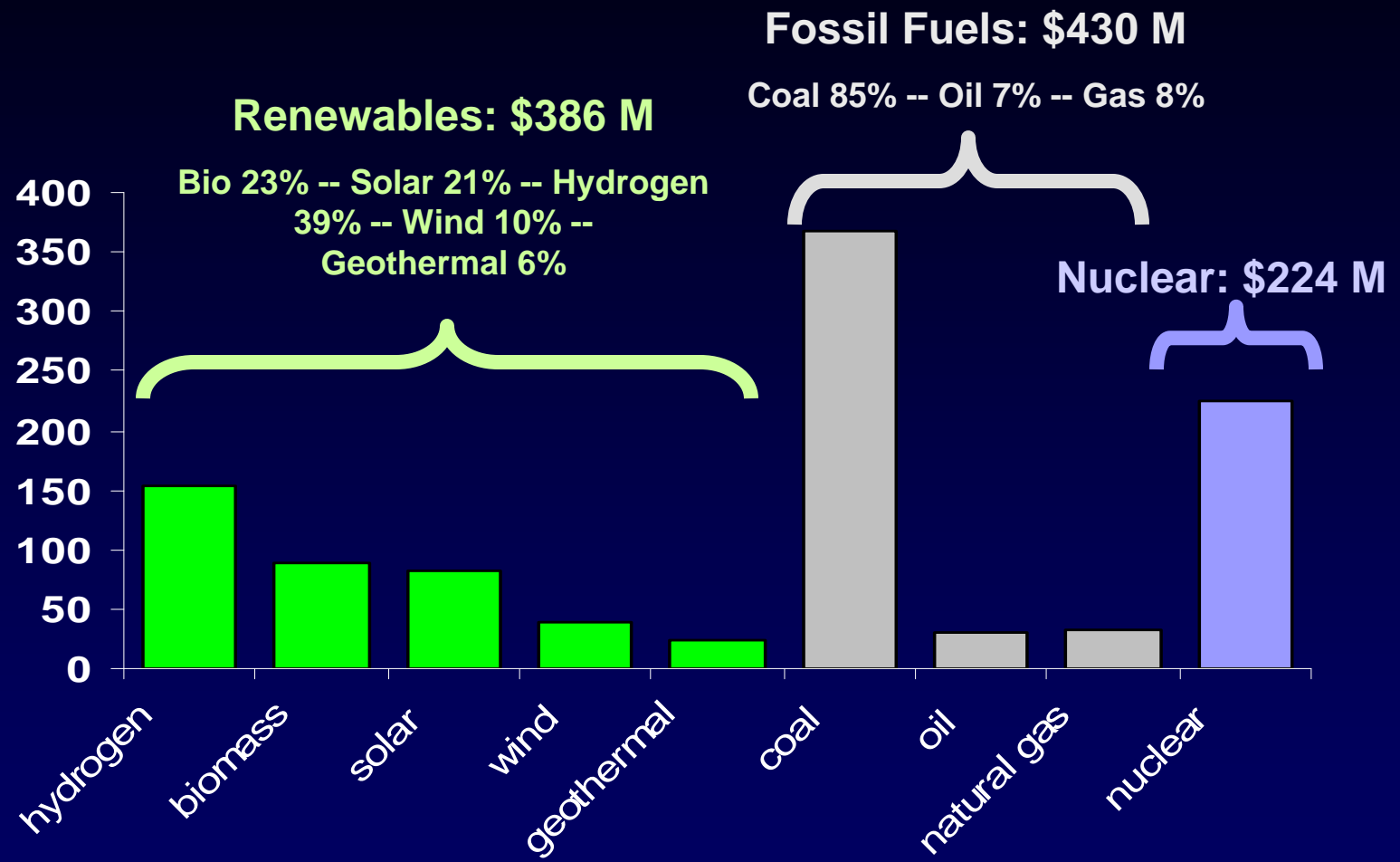
# Scale of the Technology Challenge

- ✱ The replacement cost of today's global energy-supply system—all of the power plants, transmission lines, drilling rigs, pipelines, refineries, coal mines—is in the range of \$12 trillion
- ✱ Reversing the profile of the fuel mix in 40 years – 80% fossil fuels to 80% non-fossil fuels



# Administration Priorities

# DOE Applied Energy R&D: FY 06 Funding



# 2006 Revised Administration Energy Policy

**In his 2006 State of the Union Address, President Bush declared .....**

**“America is addicted to oil, which is often imported from unstable parts of the world. The best way to break this addiction is through *technology*.**



**Since 2001, we have spent nearly \$10 billion to develop cleaner, cheaper, and more reliable alternative energy sources -- and *we are on the threshold of incredible advances.*”**



# Bush Administration Policy Thrust: Cure US “Addiction to Oil”



## New/ Additional Policy/ Investment Focus

- Biofuels
- Coal gasification
- GNEP
- Hydrogen
- Solar
- Vehicle Technology



# Biomass to Biofuels Initiative



Crop Residue:  
428 dry tons/yr.



Forest Resources:  
368 dry tons/yr.

Grains:  
77 dry tons/yr.

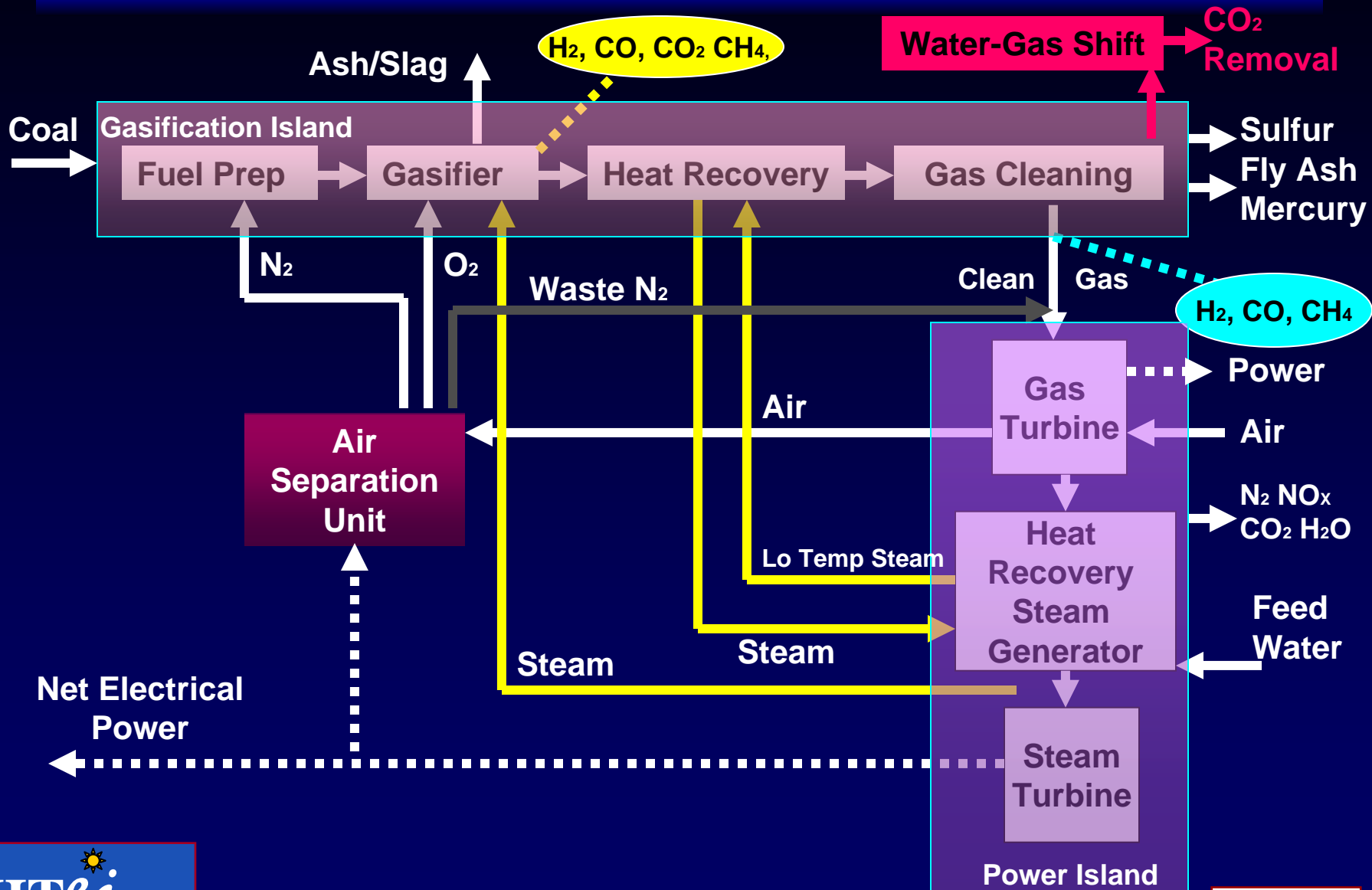
New \$250 M, 10 yr.  
program to develop US  
biomass resources

Perennial Crops:  
77 dry tons/yr.

- Gallons of ethanol to replace 30% of US liquid fuel consumption by 2030: 60 billion
- Biomass requirements at 80 gal/ton: 750 M tons
- Land requirements at 10 ton/acre: 75 M acres



# Is IGCC an Answer For Climate Change?



# Solar, Hydrogen, Nuclear



**Nuclear funding request up  
106% over FY 06 to \$347 M**



**Hydrogen funding request up  
30% over FY 06 to \$213 M**



**Solar funding request up 80%  
over FY 06 to \$148 M**

# Critical Research Roads Not Traveled (or traveled lightly)



# Federal Carbon Sequestration Program

## Transportation

Corrosion  
Materials  
CO<sub>2</sub> Impurities

## CO<sub>2</sub> Transport



Source: GTSP, 2006

## Hydrocarbon Reservoirs

Theoretical Global Capacity: 820 Gt CO<sub>2</sub>  
US Capacity: 47 Gt CO<sub>2</sub>

## Coal Seams

Theoretical Global Capacity: 140 Gt CO<sub>2</sub>  
US Capacity: 30 Gt CO<sub>2</sub>

## Saline Aquifers

Theoretical Global Capacity: 9500 Gt CO<sub>2</sub>  
US Capacity: 2730 Gt CO<sub>2</sub>

## Salt Beds

Theoretical Global Capacity: unknown  
US Capacity: 240 Gt CO<sub>2</sub>

## Risk Assessment

Comprehensive Methodologies  
Mitigation and Remediation  
Environment/Regulatory

## Integrity

Reservoir/Caprock Competence  
Well Materials  
Natural/Engineered Analogs

## Monitoring

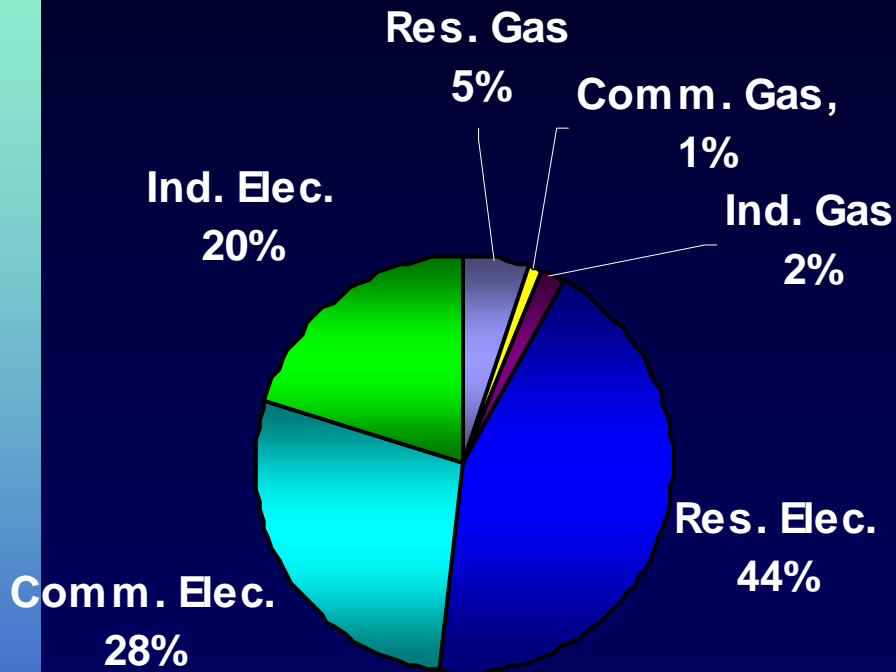
Geophysical  
Geochemical  
Satellite/Aerial  
Near Surface/  
Surface/Atmosphere

Source: CO<sub>2</sub> Capture Project  
Environmental Science and Technology

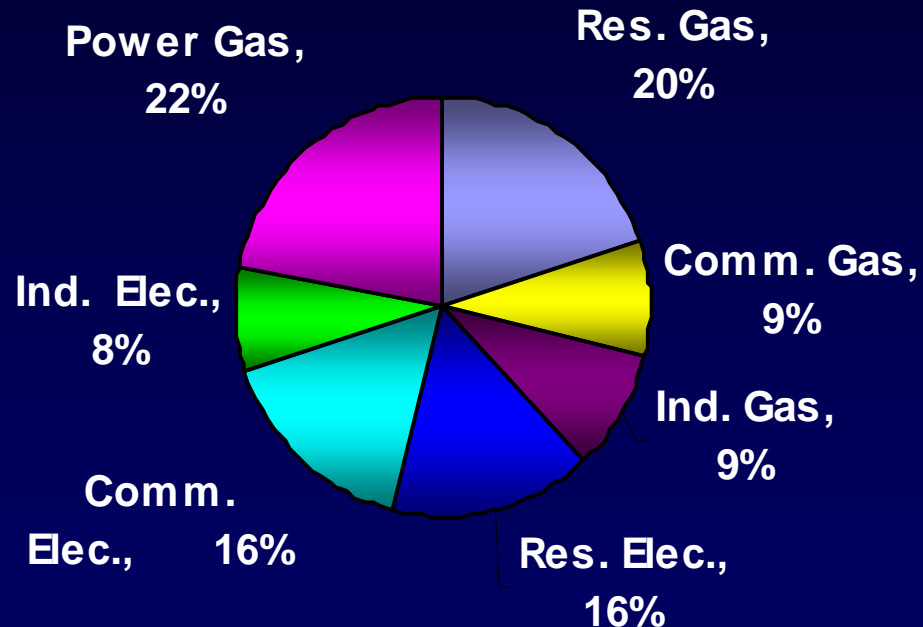


# Electricity & Natural Gas Efficiency

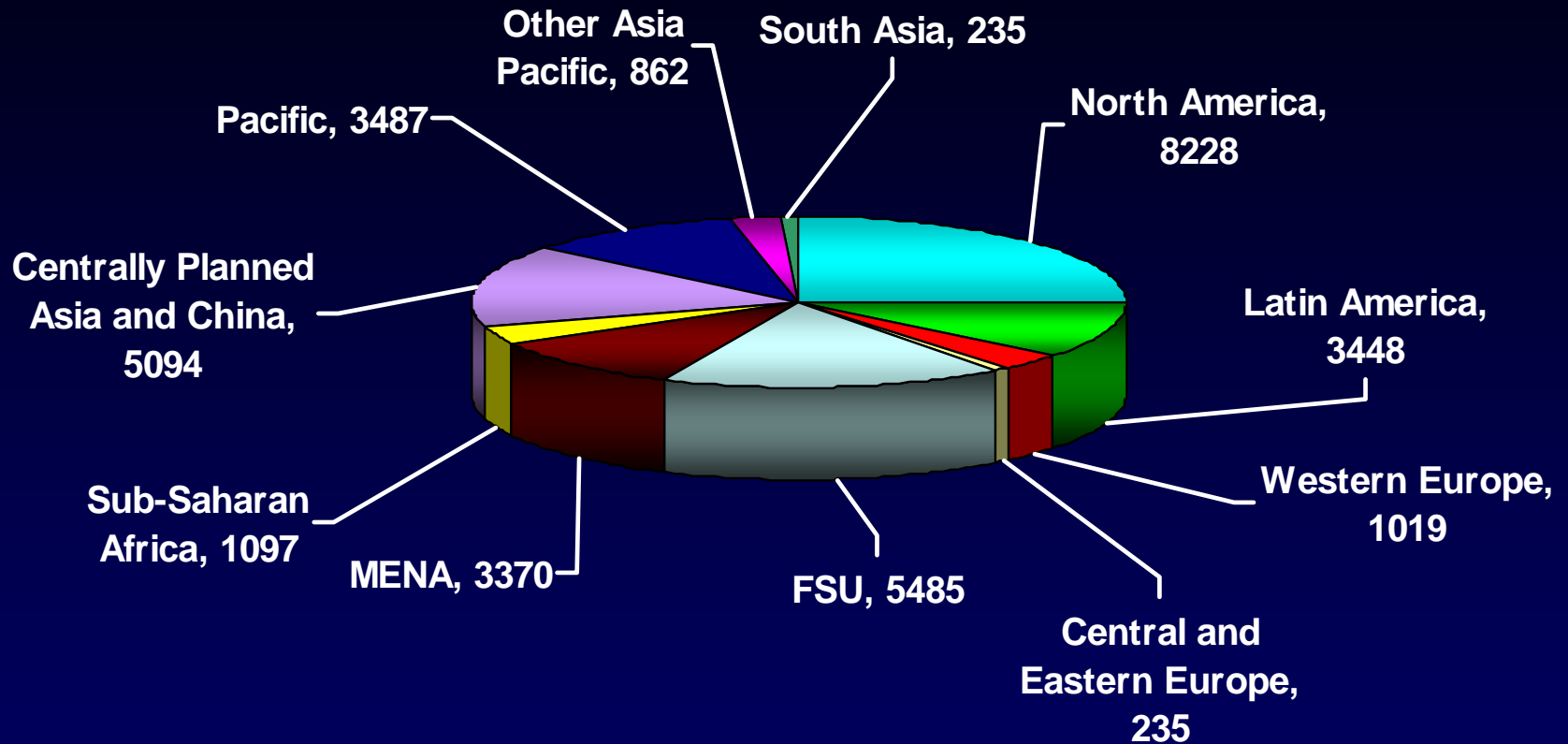
**Consumer Costs:  
\$11 billion**



**Consumer Savings:  
\$32.4 billion**



# Global Unconventional Gas Resources



**World Total: 32,560 tcf**  
**roughly 300 years of supply**



# Enhanced Geothermal Systems

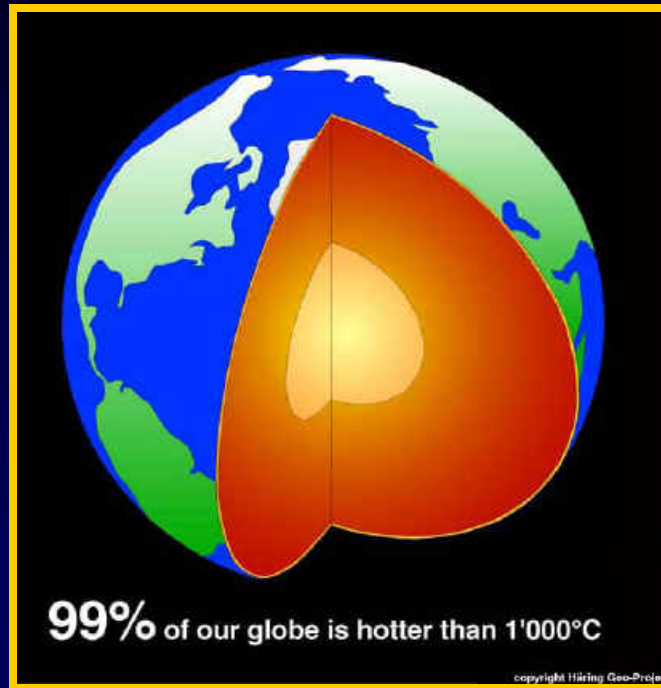
## Research Needs

**Characterization  
Drilling**

**High Quality  
Resources:  
Primarily in  
Western US**

**Fracturing  
Conversion**

**Low Quality  
Resources:  
Nationwide**



**Target Resource Base: 100 GWe in next 50 years**

# Congressional Priorities



# 2007 Energy Policy from the Legislative Branch

**Energy leaders from the House Energy Committee  
declared on recent passage of the House Energy  
legislation .....**

**“This is a historic turn away from a fossil  
fuel agenda toward renewable energy. It's  
been a long time in coming”**



**Congressman Ed Markey**

# Regional Energy Resources

## Northern Plains

Lignite

Oil, Gas

Sub-bituminous Coal

Unconventional Gas

Wind

Bituminous Coal

Unconventional Gas

Geothermal

## Northwest

Wind, Energy

Hydro

Offshore Gas/Oil, Coal

Texas/Louisiana

Oil, Gas, Unconventional Gas

Gas, Sub-bituminous Coal

Wind

## Midwest

Sub-bituminous Coal,

Ethanol

## Southeast

Wind, Offshore Gas

and Oil

# Regional Energy Issues

## Southeast

Resource constrained, offshore moratoria, coal fired power but poor sequestration

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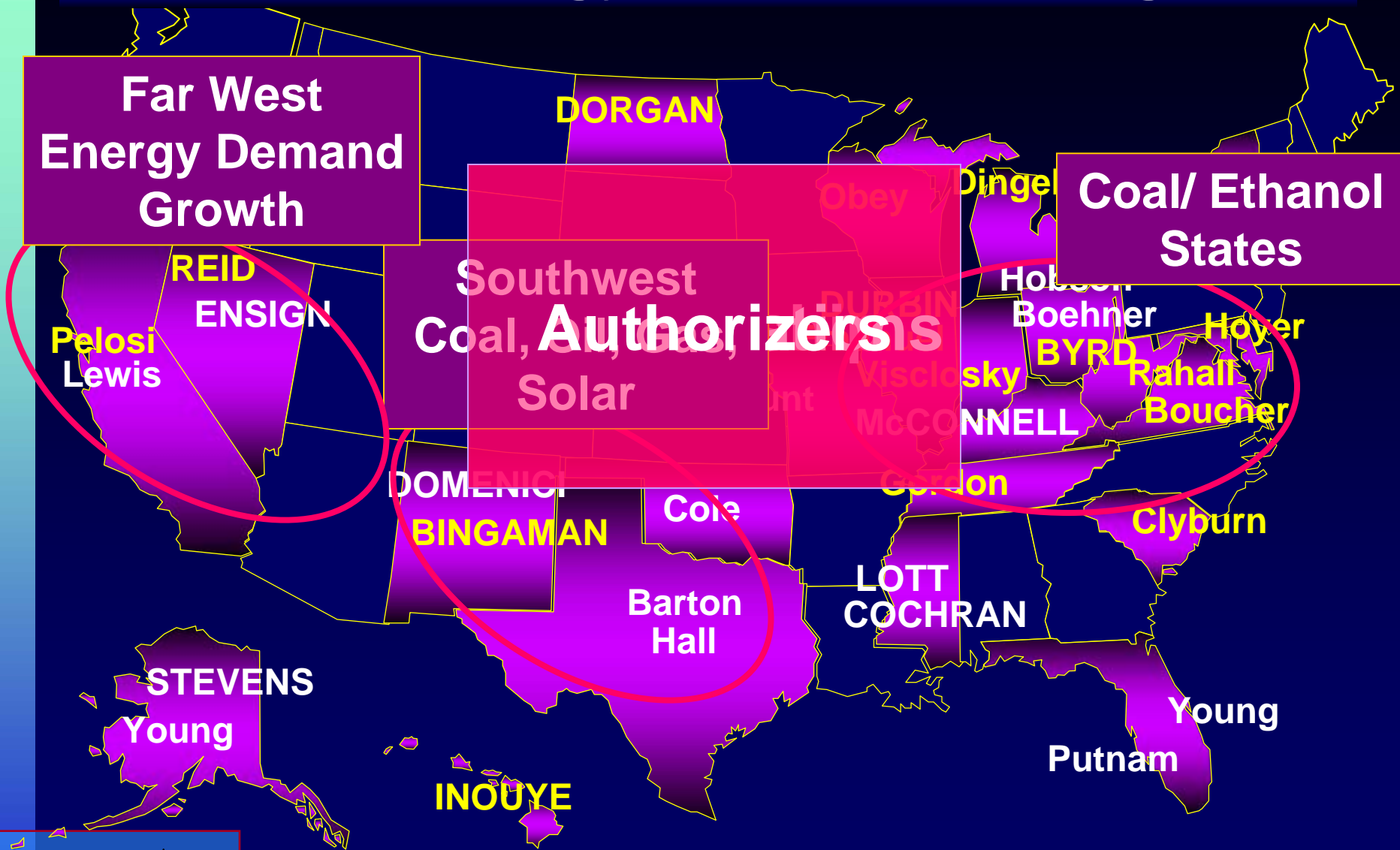
## Midwest

Natural gas, nuclear heavy, efficiency needs, demand destruction, ethanol to markets, sequestration needed  
carbon sequestration

Not currently meeting policy makers, high demand, maturing resource base, need for resource diversification, non-attainment



# Focus on Energy: The 110<sup>th</sup> Congress



# Energy Focus in 110<sup>th</sup> Congress

## LOSERS

- Oil and natural gas supply
- Distributed generation
- Industrial efficiency
- Thermo- chemical conversion of biomass
- Funding for large demonstration projects

## WINNERS

- Coal gasification
- Cellulosic ethanol via chemical conversion
- Methane hydrates
- Solar
- Geothermal
- Building efficiency
- Loan guarantees
- Basic energy sciences

## “JURY’S OUT”

- Hybrid vehicles
- Hydrogen
- Nuclear
- “FutureGen”
- CCS
- Innovation policy
- Cap and trade



Does this get us from here  
to there?

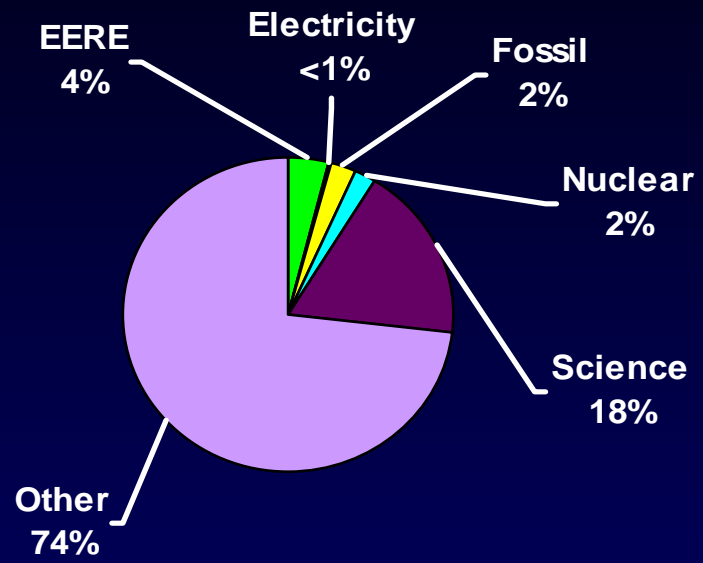


# Energy Innovation/Research Investments

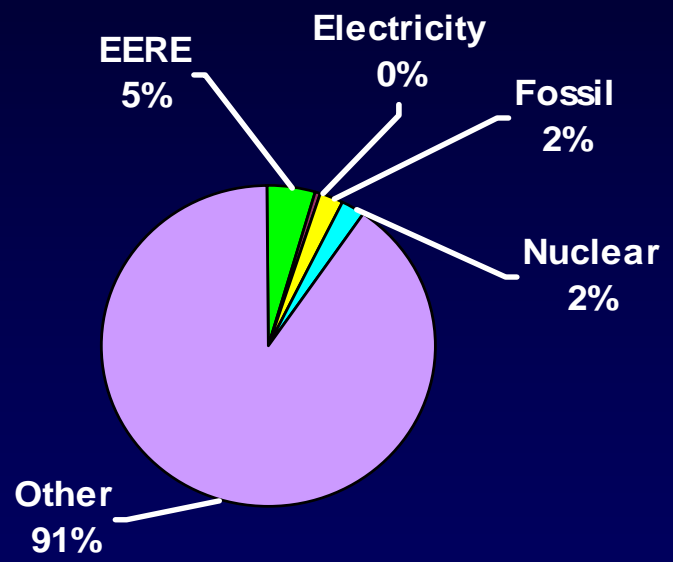
- ✱ In a \$45 trillion world economy, \$3 trillion for energy, total public and private investments in energy RD&D is in the range of \$15-20 billion, one half a percent of energy expenditures and 0.03 percent of world GDP.
- ✱ U.S. public and private spending on energy-technology RD&D totals only \$5-6 billion per year, less than one percent of what this country spends for electricity and fuels.



# DOE Budget Breakdown: FY 08 Budget Request



**Assuming Office of Science As Basic Strategic "Energy R&D"**



**Assuming Office of Science As Basic, Not Strategic, Research**



# Challenges, Policies, Pathways

## Challenge

## Policy

## Pathways

### Increased Demand

The uneven distribution of oil and gas supplies and productive capacity, non-assured access to those supplies, and volatile energy prices threaten national, regional, and world stability and economies

### Climate Change

Environmental stress increases the potential for regional political instability and tensions

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- Develop oil alternatives
- Diversity oil supplies
- Decrease oil demand
- Develop gas alternatives
- Increase gas supplies
- Decrease gas demand
- Increase Fossil Fuel Efficiency
- Promote Carbon Capture & Sequestration
- Develop Carbonless Energy Technology



- Gas-to-Liquids
- Coal/Biomass-to-Liquids
- Biofuels
- Heavy Oil/Tar Sands
- Higher Efficiency Advanced Vehicles
- Hydrogen Vehicles/Infrastructure
- Wind, Solar, Geothermal, Nuclear, Gasification
- Unconventional/UDW/Hydrates
- GTL, CNG, LNG
- Efficiency, Advanced Turbines, Efficient Buildings, Appliances, Boilers, CHP
- Advanced Vehicles
- Efficient Power Generation
- Industrial processes, CHP
- Capture Ready Technologies
- Geologic Reservoir Development
- Capture Technologies
- Advanced Sequestration Technologies
- Renewables/nuclear capital cost reduction
- Nuclear Spent Fuel Management
- Advanced modular nuclear reactors

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- **Piecemeal approach, no overarching strategy**
  - **Technologies not well understood**
    - **Technology de jour**
  - **Insufficient policy analysis and support**
    - **Inadequate funding**
- **DOE not really the Department of Energy – we need a much more focused DOE to address the significant challenges we are facing**
- **Reorganize energy programs around end uses to get a portfolio approach to research, critical**

