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"Overview of Current U.S. Energy Production and Consumption and Future Considerations"

Energy Systems (ENG300)
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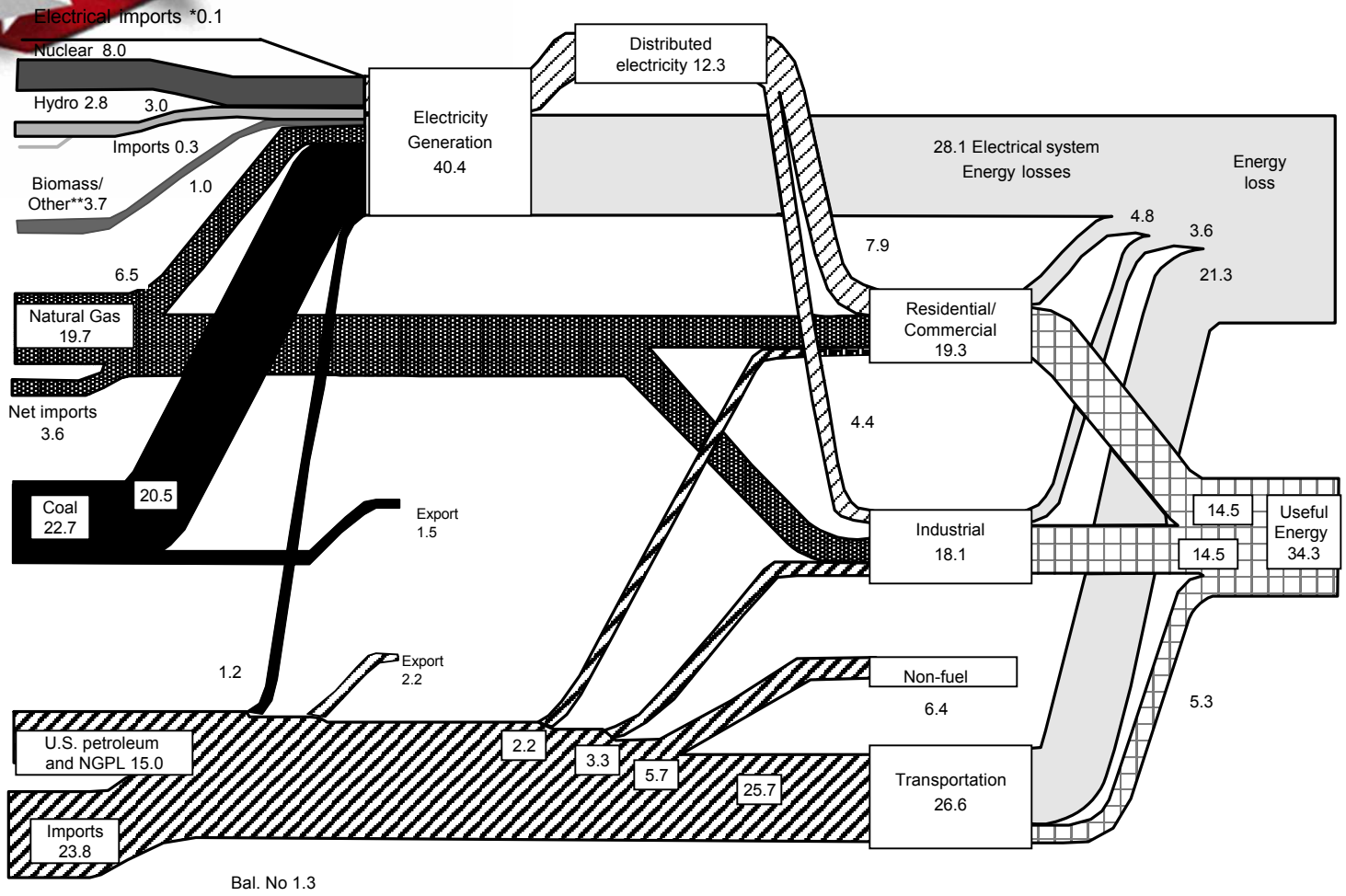
Presentation Outline

- Overview of current U.S. energy supplies, energy production and flows, and usage by sector
- Discussion and examples of how energy flows can be used to understand energy technology and policy issues
- Projections of future energy supplies
- Emerging energy issues and energy surety concepts
- Homework problem!
- Suggested “special topics” for class presentations

Current U.S. Energy Supplies, Usage, and Flows

FY 2000 U.S. Energy Flows



Values in Quadrillion BTUs (quads) with Total Quads=100 in 2000

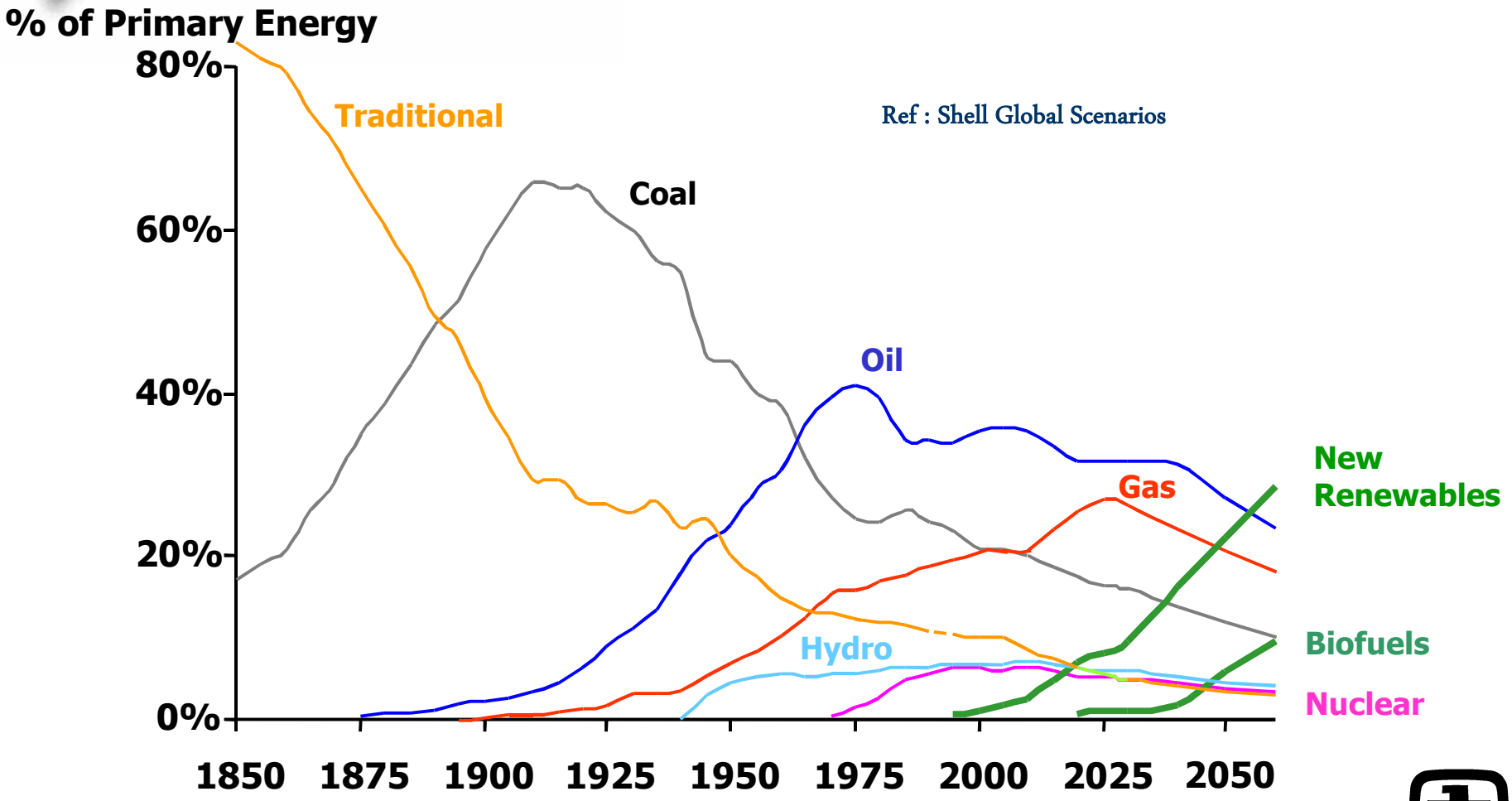
Source: Production and end-use data from Energy Information Administration. Annual Energy Review 2000
*Net fossil-fuel electronic imports
**Biomass other includes wood and waste, geothermal, solar, and wind.

Using the "Spaghetti Chart" to Understand Energy Issues

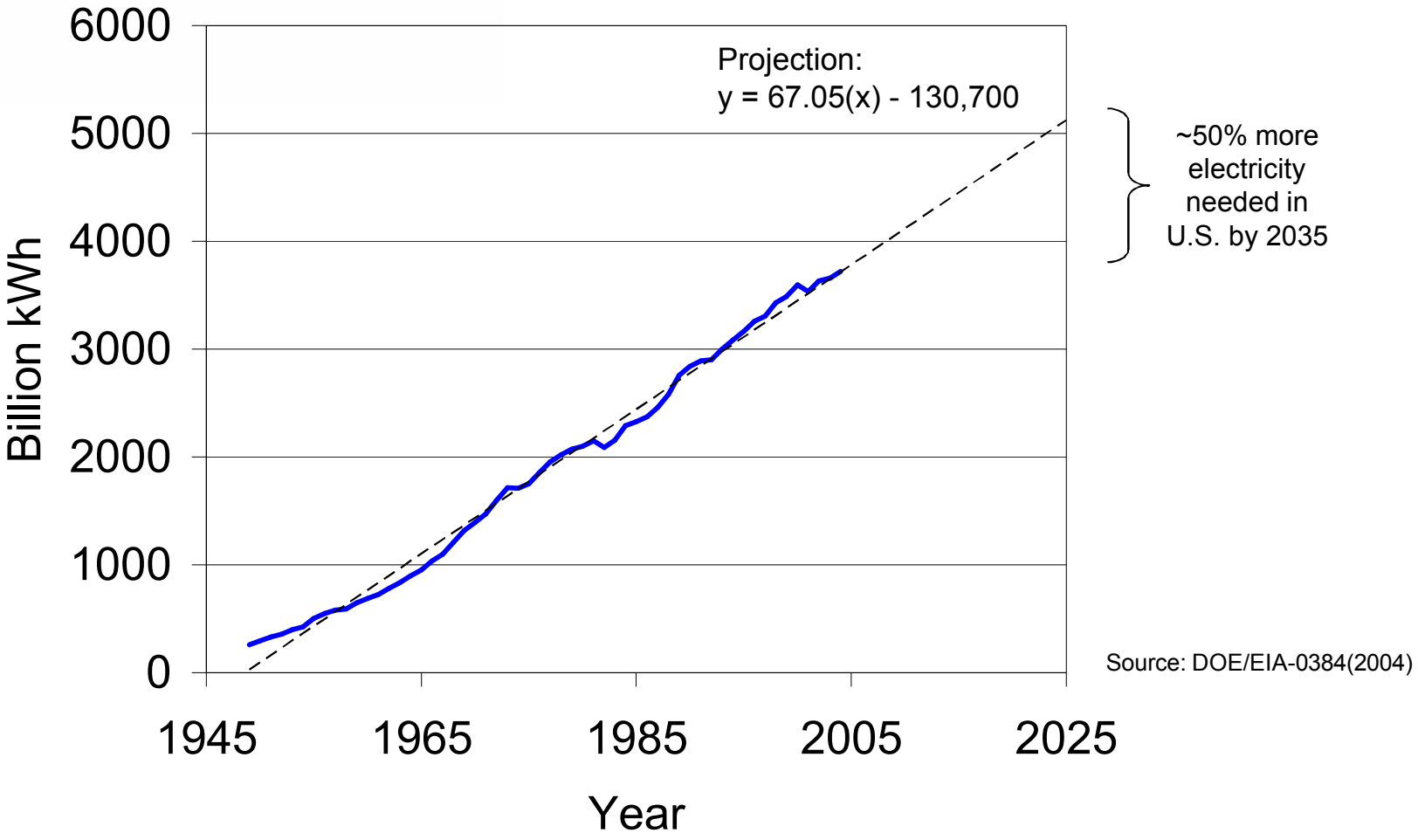
- Nuclear energy role in U.S. energy supply and in electric energy production?
- Is the U.S energy supply vulnerable, how much is imported and for what?
- Benefits of solid-state lighting on oil imports? On energy efficiency and future power plant needs?
- Are there benefits of higher fuel efficiency standards for cars? For cars and trucks?
- Where are energy efficiency technology improvements most productive?

Projections of Future Energy Production and Supplies

The Evolving Energy Mix

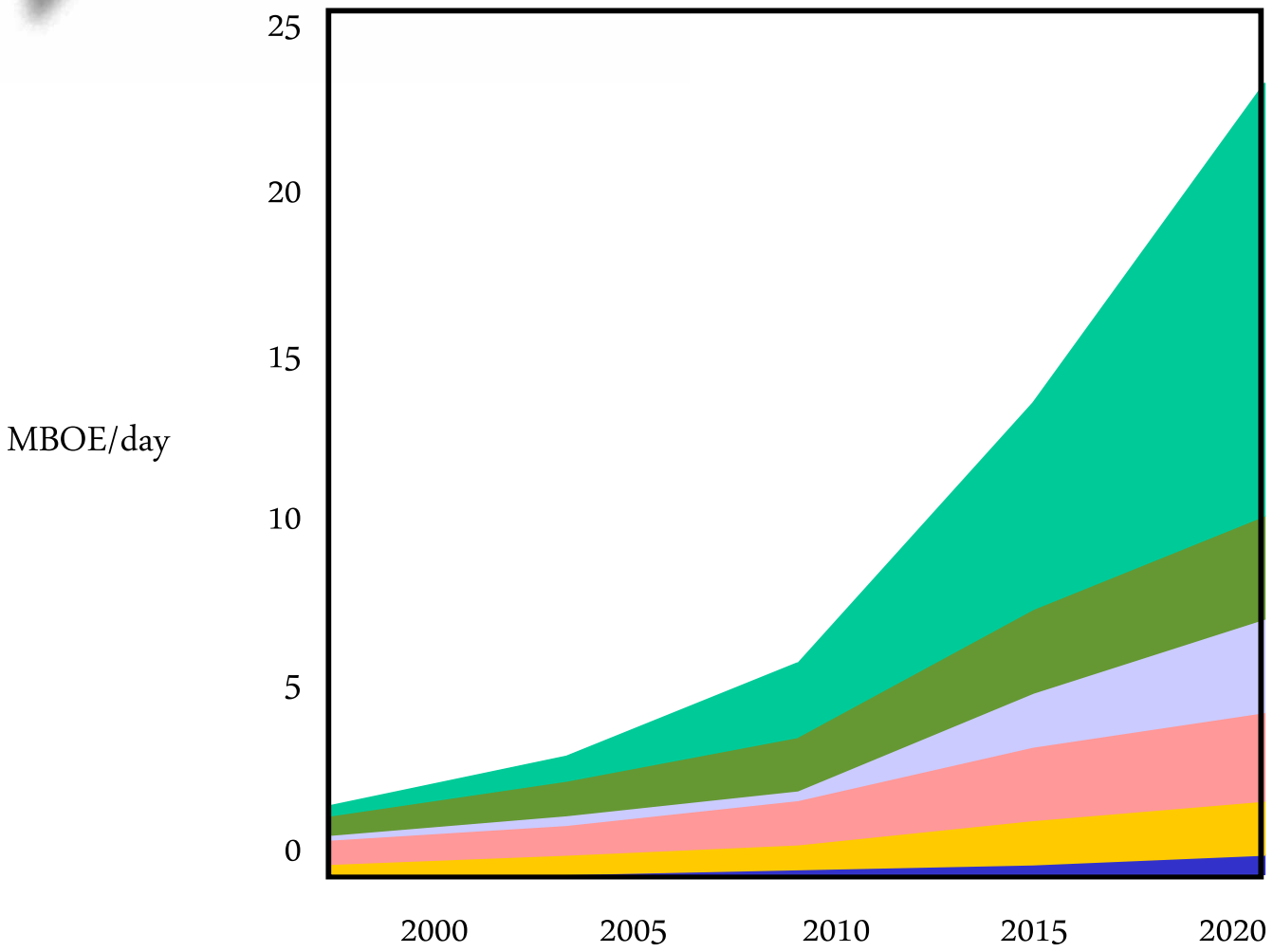


The U.S. will need 50% more electricity by 2035



Source: DOE/EIA-0384(2004)

RE Growth Predictions



Ref: Shell Global Scenarios

European RE Goals

TYPE OF ENERGY	1995 EUROSTAT	2000 EUROSTAT	WHITE PAPER TARGETS 2010	REVISED TARGETS 2010
1. Wind	2.5 GW	12.8 GW	40 GW	75 GW*
2. Hydro	92 GW	94.6 GW	105 GW	105 GW
3. Photovoltaics	0.03 GWp	0.09 GWp	3 GWp	3 GWp
4. Biomass	44.8 Mtoe	54.3 Mtoe	135 Mtoe	125 Mtoe
5. Geothermal	2.5 Mtoe	3.33 Mtoe	5.2 Mtoe	6.2 Mtoe
6. Solar Thermal Collectors	6.5 Mio m^2	9.7 Mio m^2	100 Mio m^2	75 Mio m^2

*** - 10 GW Offshore**

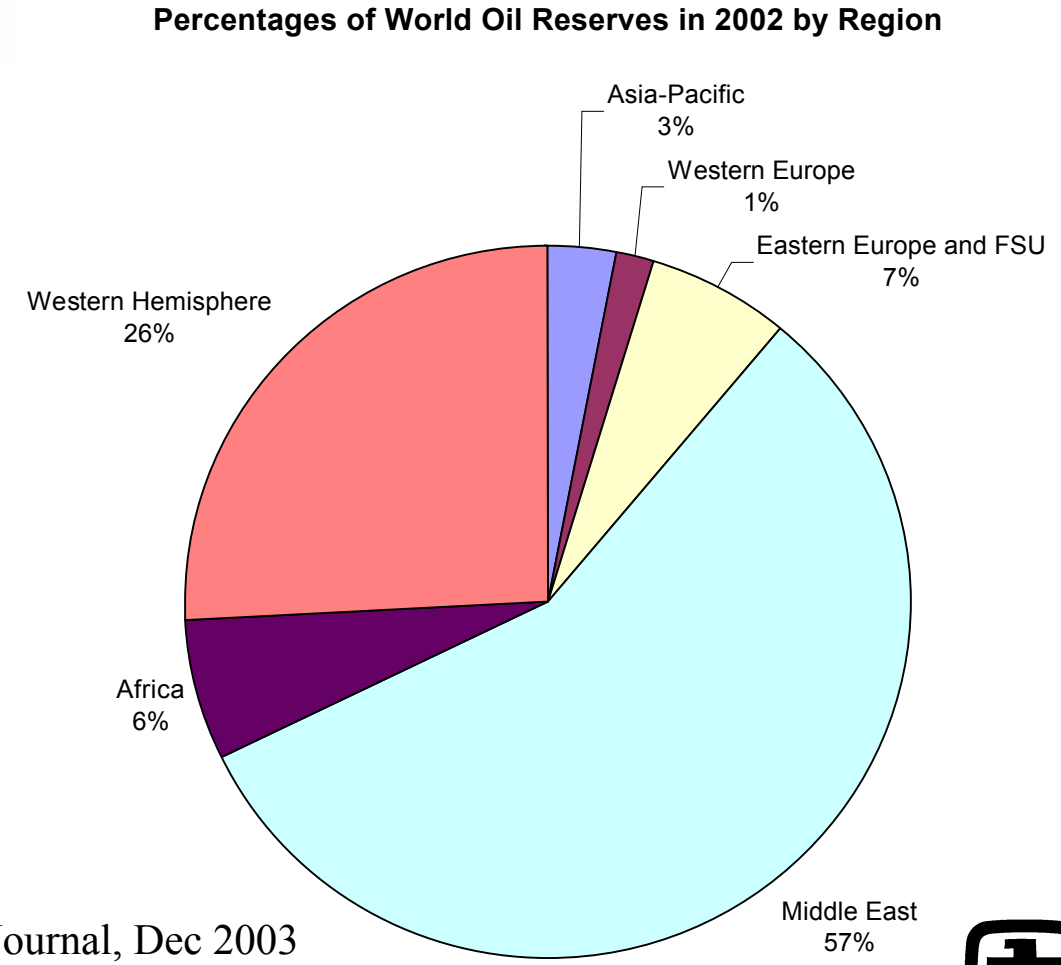
Ref: Zervos, Arthouros, "The Future of Renewable Energy," European Wind Energy Conf., Madrid, Spain, June, 2003

EIA Projected New Electric Power Generation Capacity through 2035

- Coal
  - 350, 400 MW steam turbine plants (140,000 MW)
- Natural Gas
  - 150, 100 MW natural gas combined cycle (15,000 MW)
- Renewables
  - 125, 200 MW wind or solar farms (25,000 MW)
- Nuclear
  - 5, 1000 MW nuclear reactors (5,000 MW)
- Hydroelectric
  - None (~40,000-60,000 MW available)

World Fossil Energy Reserves and Supplies

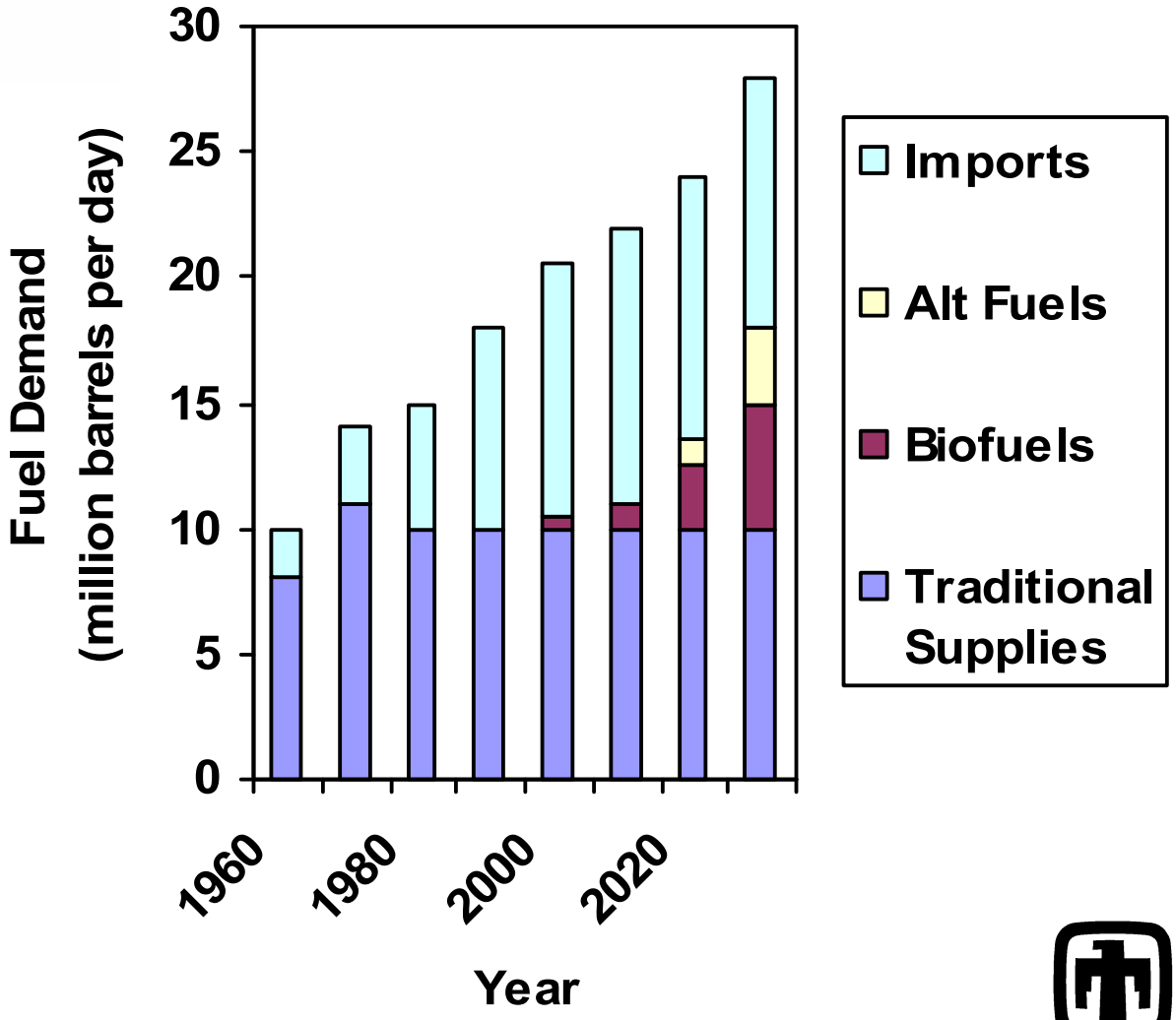
- Oil – Middle East and Western Hemisphere
- Middle East of Gas-Russia
- Middle East of Coal-United States
- Energy reserves vary based on costs and technology improvements



Ref. Oil and Gas Journal, Dec 2003

The U.S. will need 33% more Transportation Fuels by 2030

- Fuel use will increase despite gains in efficiency
- Current initiatives for domestic alternatives like oil shale, coal-to-liquids and biofuels
- Major hydrogen use will be post 2030



Emerging Energy Issues and Energy Surety and Energy System Concepts

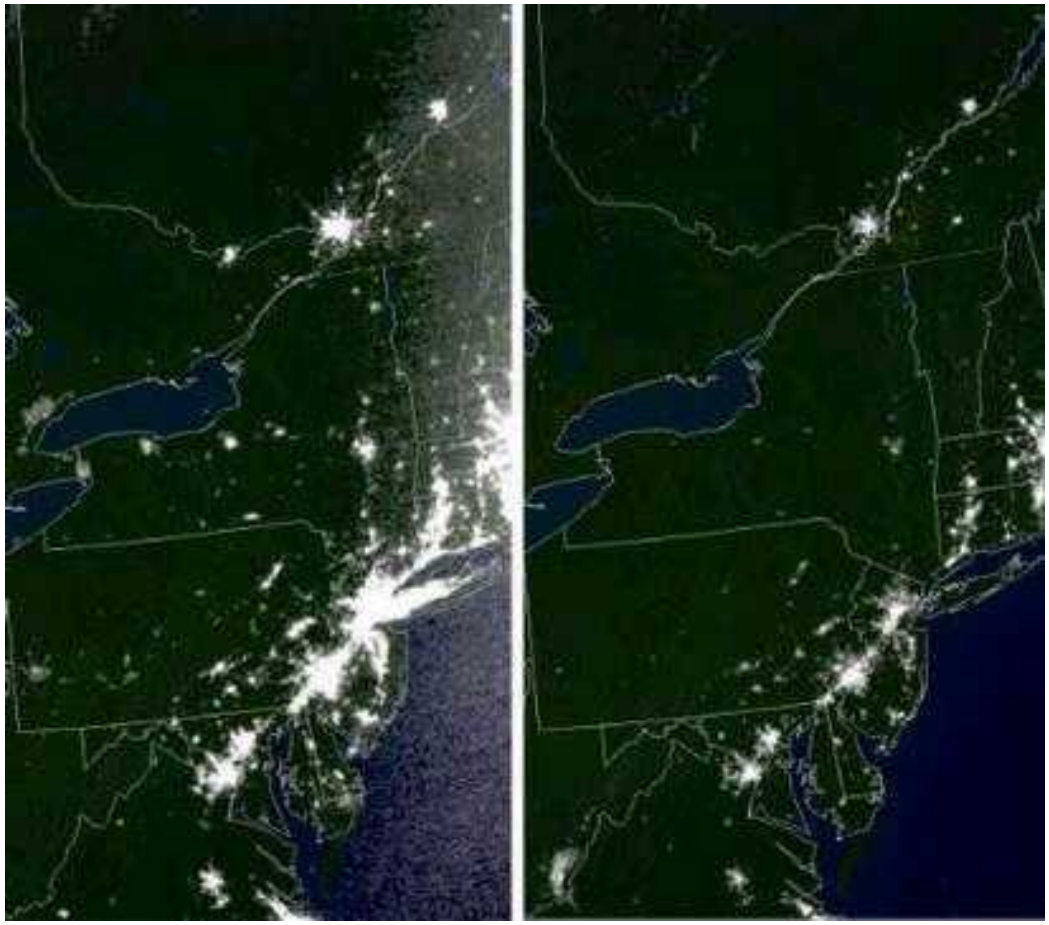
Energy Surety

”an integrated approach to security, reliability, safety, and sustainability”

Growing Global Energy Resource Demands Raise Significant Issues

- Global Energy Consumption/person
  - US – 800 kwh/mo (30% of worlds energy consumption)
  - India – 25 kwh/mo
  - China – 15 kwh/mo
- Global Transportation, vehicles/1000 people
  - US – 800
  - India – 60
  - China - 70

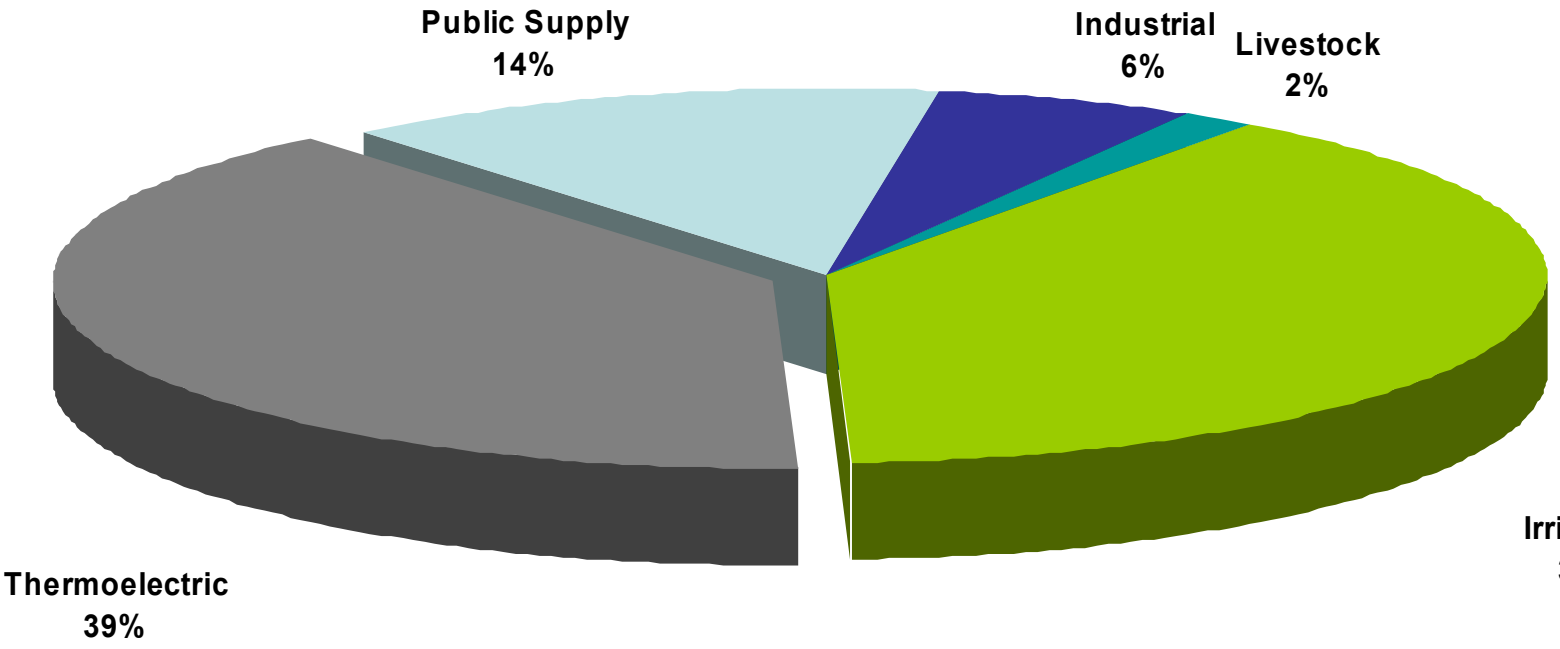
Growing Energy Reliability Issues and Concerns in U.S



NE Blackout 2003

Growing Sustainability Issues and Concerns

Estimated Freshwater Withdrawals by Sector, 2000

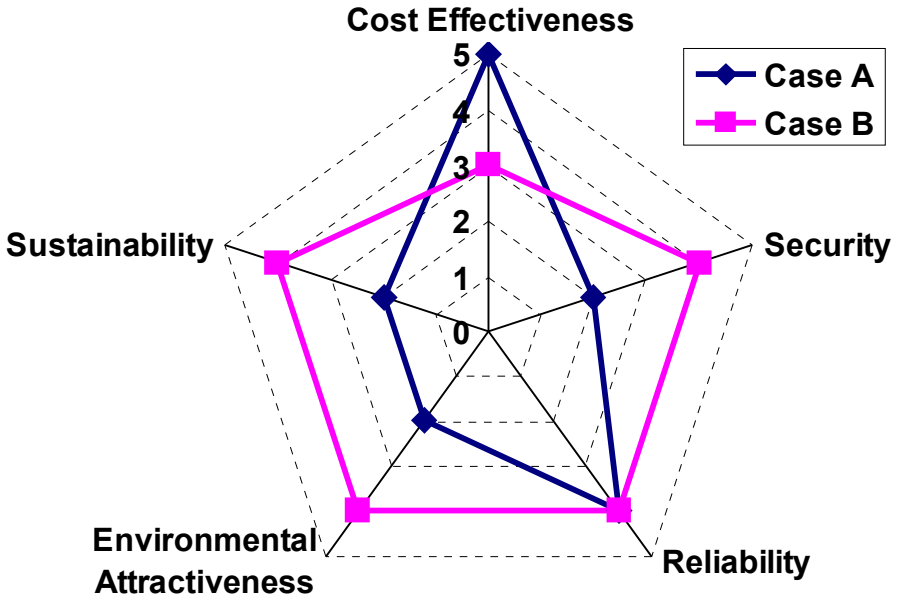


Source: USGS Circular 1268, March, 2004

Growing Environmental and Ecological Issues and Concerns

U.S Energy System Surety Transition

- **Reliability, security, sustainability, as well as cost will be future drivers**
- **May need to revise energy optimization criteria**
- **More diverse energy supply and production portfolio may be required**
- **Energy efficiency may be a major element**



Environmentally Friendly, Secure, Reliable, and Sustainable Energy Future?

- Hydrogen
- Wind
- Hydroelectric
- Solar - photovoltaic and concentrating
- Geothermal
- Biomass - direct combustion and ethanol
- Oil and Natural Gas
- Coal - pulverized and combined cycle
- Nuclear

Is there a free Lunch?

Homework Assignment

- Unencumbered by facts (like all good policy makers) and based on “energy surety” parameters, estimate what you think an appropriate energy mix should be in the U.S in 2025 and 2050.
- Submit no more than 2 paragraphs on reasoning behind the suggested mix at class on Sept. 16th .
- Information on the general trends of the suggested mixes will be provided at my next presentation (Session 9).
- We will repeat the assignment at the end of the class, after everyone has had a chance to receive more in-depth information on energy technologies, supplies, and issues.

"Special Topics" for Consideration as Presentations

- Identify an approach (model, spreadsheet, numerical weighting criteria, etc.) to identify appropriate or an optimum U.S. energy mix based on "energy surety" and "energy system" parameters for 2025 and/or 2050.
- Develop a suggested energy policy at a local, national, or regional (North America) level that can transition from the current energy portfolio to an improved energy portfolio, as defined by "energy surety" and "energy system"concepts, in the 2025 to 2050 time frame. Policy can include incentives, production tax credits, etc.