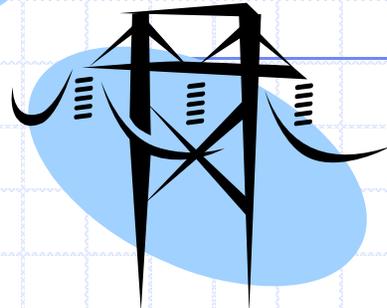
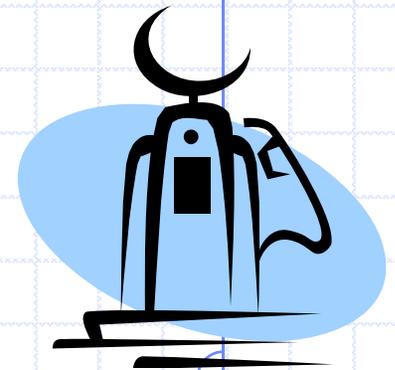
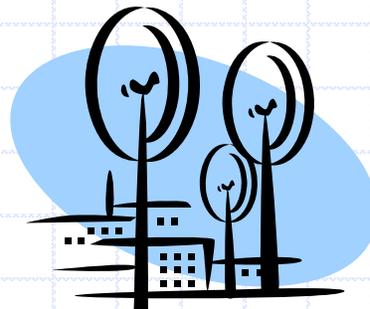


# Energy Security & The Role of High Performance Modeling and Simulation

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# Outline

- ◆ Interest in Energy Security
- ◆ A Few Definitions
- ◆ Achieving Energy Security
- ◆ Factors To Be Considered
- ◆ Role of High Performance Modeling and Simulation
- ◆ Summary



# Interest in Energy Security



President George W. Bush addresses members of the Securing America's Future Energy organization Monday, Jan. 29, 2007, in the Roosevelt Room at the White House, discussing the efforts to reduce America's dependence on oil. From left to right are Mike Jackson, chairman and CEO of Auto Nation; Herb Kelleher, executive chairman of Southwest Airlines Company and General P.X. Kelley, USMC (Ret). White House photo by Eric Draper

## President Bush Meets with Members of Securing America's Future Energy

"Their plan and my plan ...have got commonalities, and we're going to work together to get Congress to enact a comprehensive plan. I believe there's an appetite in the halls of Congress to become less dependent on oil. I believe there's a knowledge in Congress that when we spend money on cellulosic ethanol that will make us less dependent on oil."

-- President George W. Bush  
January 29, 20

## Energy Security is National Security

Barrack Obama

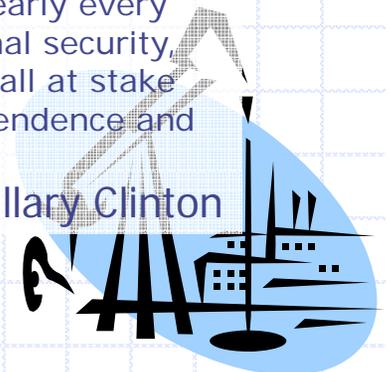
Overall, I am committed to:

- A balanced approach to energy security that increases domestic supplies, reduces demand for oil and gas, and promotes alternative fuels and other diverse energy sources.
- Investing in renewable and alternative fuels to promote greater energy independence and a cleaner environment.
- An energy policy that invests in the advanced technologies of tomorrow and places more emphasis on conservation and energy efficiency.
- Conducting research and development into technologies that improve the environment, especially the reduction of CO2 emissions.

Fred Thompson

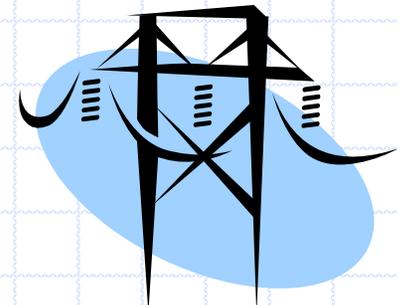
The choices we make about energy touch nearly every aspect of our lives. Our economy, our national security, our health, and the future of our planet are all at stake as we make a choice between energy independence and dependence on foreign sources of oil.

Hillary Clinton



# A Few Wikipedia Definitions

- ◆ **Energy** - In physics and other sciences, energy (from the Greek energos, "active, working") is a scalar physical quantity that is a property of objects and systems of objects which is conserved by nature. Several different forms, such as kinetic, potential, thermal, electromagnetic, chemical, nuclear, and mass have been defined to explain all known natural phenomena.
- ◆ **Security** - Security is the condition of being protected against danger or loss. In the general sense, security is a concept similar to safety. The nuance between the two is an added emphasis on being protected from dangers that originate from outside.
- ◆ **Energy Security** - Energy security, or security of supply, is the ability to supply energy to meet demand at a price that protects economic growth.



# Energy Types and Usages

## ◆ Fossil

- Oil
- Natural Gas
- Coal

## ◆ Nuclear

## ◆ Renewable

- Biomass
- Hydro
- Wind
- Solar
- Geothermal

## ◆ Usage

- Transportation fuels  
(carry your energy with you)
- Fixed production
- Fixed consumption



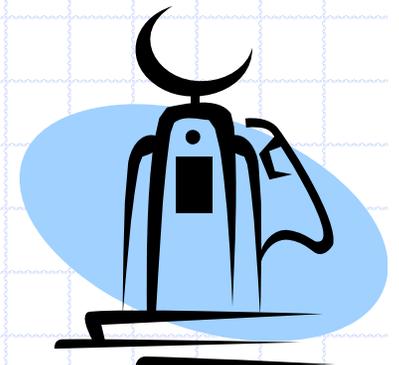
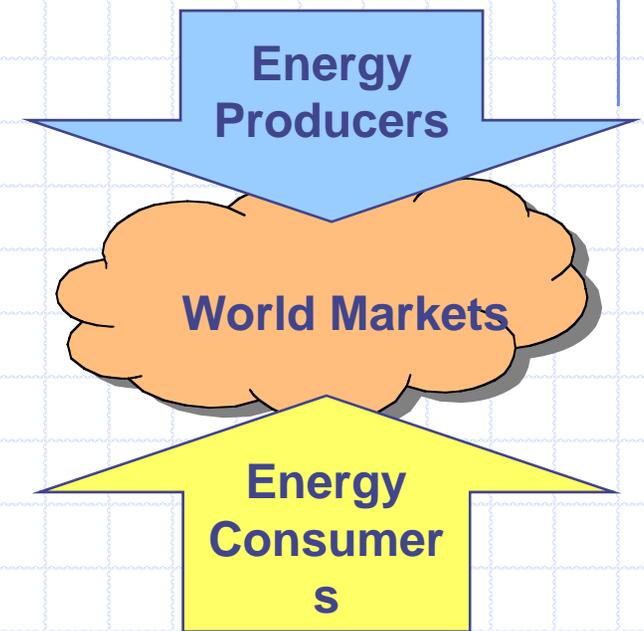
# Achieving Energy Security

## ◆ Energy Independence

- The ability to independently produce all of the energy required to support a country's economic requirements.
- Nice idea, but seldom practically achievable

## ◆ Energy Assurance

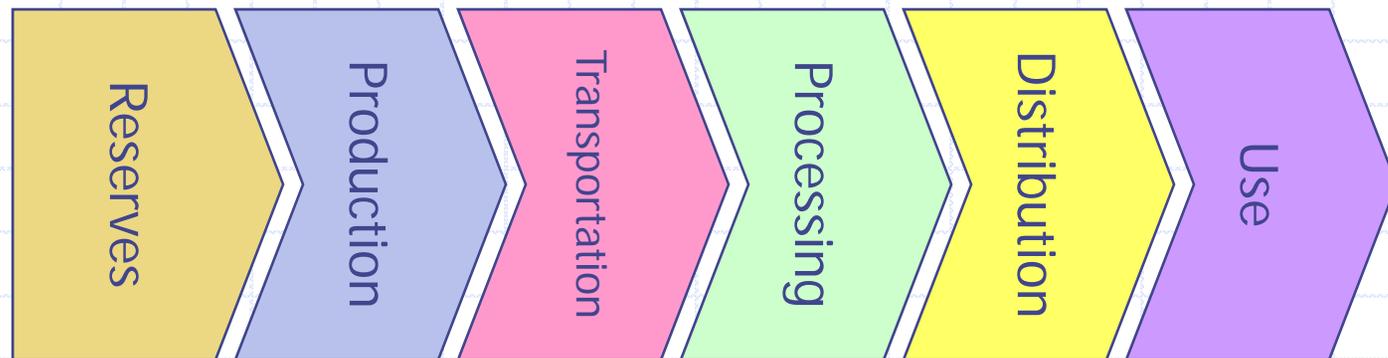
- The ability to reliably obtain the energy needed to support a country's economic requirements.
- Producer – dependent of the need to sell energy
- Consumer – dependent of the need to buy and consume energy
- Many countries are both



# Energy Security Factors

## ◆ Sum of the Reliability of Energy:

- Reserves
- Production capabilities
- Transportation
- Processing
- Distribution



# Energy Security Factors

## ◆ Security Threaten by:

- Weather
- Natural phenomena (e.g. earthquakes)
- Accidents
- Geography
- Geopolitical factors
- Terrorism
- Economic factors

## ◆ Security Enhanced by:

- Reduced dependence on energy (conservation)
- Good geopolitical relationship
- Open markets
- Excess capacity
- Flexibility to change energy types
- Advanced technology

**Bottom Line** - Lots of threats (and in some ways getting worse), but few security enhancements



# Improving Energy Security - Role of Advanced Technology and HPC

## ◆ Oil & Natural Gas

- Locate additional sources
- Improve production techniques

## ◆ Renewables (wind, solar, biomass, hydro)

- Improve production efficiencies
- Understand overall impacts

## ◆ Coal

- Reduce undesirable emissions

## ◆ Nuclear

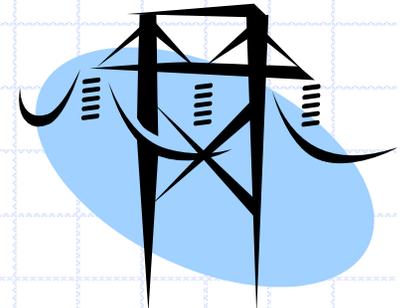
- Close the nuclear fuel cycle
- Waste forms and repository

## ◆ Electricity

- Transmission
- Storage

## ◆ Understanding and predicting the effects of threats

- Weather modeling
- Economic modeling
- Natural (earthquake) phenomena
- Others



# Improving Energy Security - Role of Advanced Technology and HPC

## ◆ Understand the impacts of energy consumption

- Climate change
- Economic
- Actions to mitigate
  - ◆ Carbon emission reductions
  - ◆ Carbon sequestration

## ◆ Improving energy security enhancements

- Ability to switch to different types of energy
- Improvements in the efficiency of the production, transportation, processing and use of various forms of energy
- Improve energy conservation



# Summary

- ◆ The best **Energy Security = Energy Assurance**
- ◆ Achieved by:
  - Making “best” use of the currently available energy
    - ◆ Effective and efficient production and consumption
    - ◆ Economically viable
    - ◆ Environmentally friendly
  - Developing new and/or different sources of energy
  - Predicting and mitigating threats to energy security
  - Supporting enhancements to energy security
- ◆ Advanced technologies and HPC can play an important role in all of the above

