

# Basic Research Needs for Electrical Energy Storage

Report of the Basic Energy  
Sciences Workshop on  
Electrical Energy Storage  
April 2-4, 2007



# Session on Energy Storage

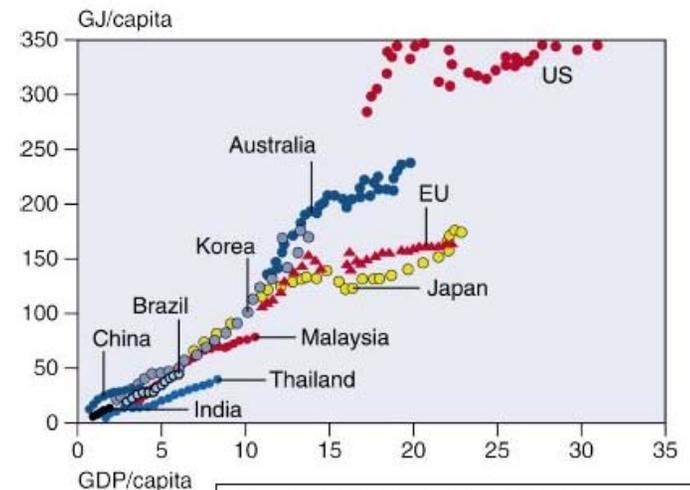
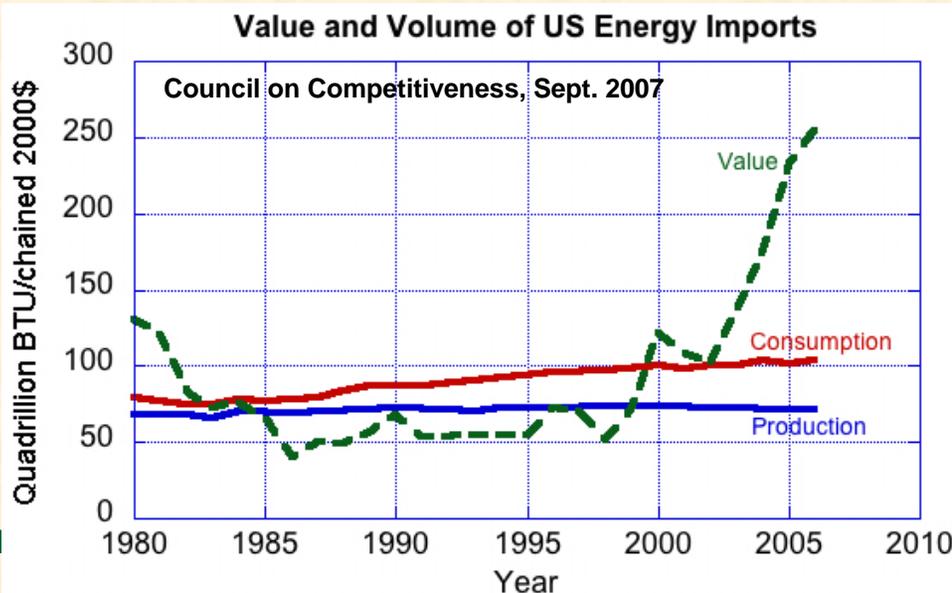
## Panel

- **Yury Gogotsi, Drexel University----Plenary Talk**
- **Jim Roberto, Oak Ridge National Laboratory**
- **Jim Davenport, Brookhaven National Laboratory**
- **Doug Kothe, Oak Ridge National Laboratory**

**Gil Weigand, Oak Ridge National Laboratory**

# The US is increasingly reliant on imported and ever more costly energy sources

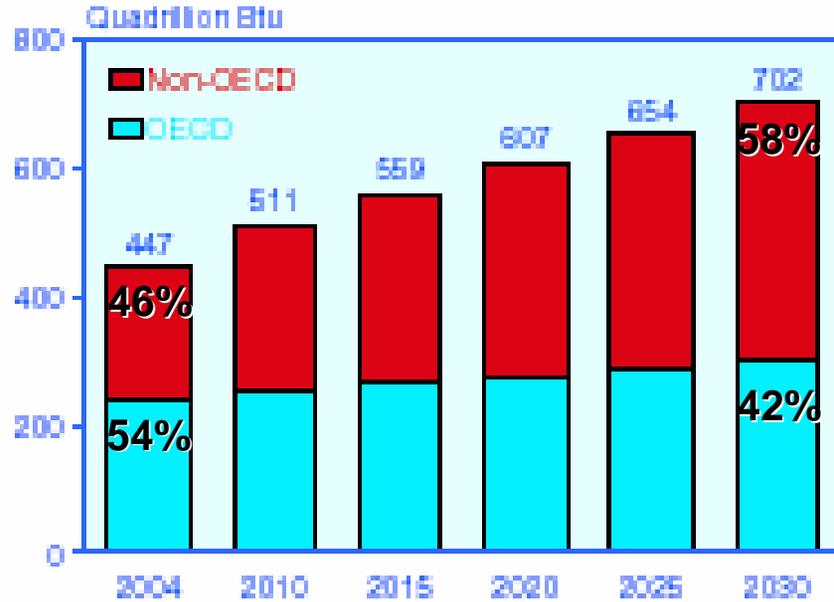
- **Profound impact on energy assurance**
  - Economic security (linkage between energy use and GDP)
  - Environmental security (US and worldwide)
  - Energy security (no brownouts/blackouts)
  - National security (reliance on foreign energy sources with unstable political governance)
- **When will energy assurance “tipping point” be achieved?**



Source: Royal Dutch Shell, "Exploring the Future - Energy Needs, Choices and Possibilities"

# Ability of US to obtain sustainable energy to support its economy and lifestyle is being threatened

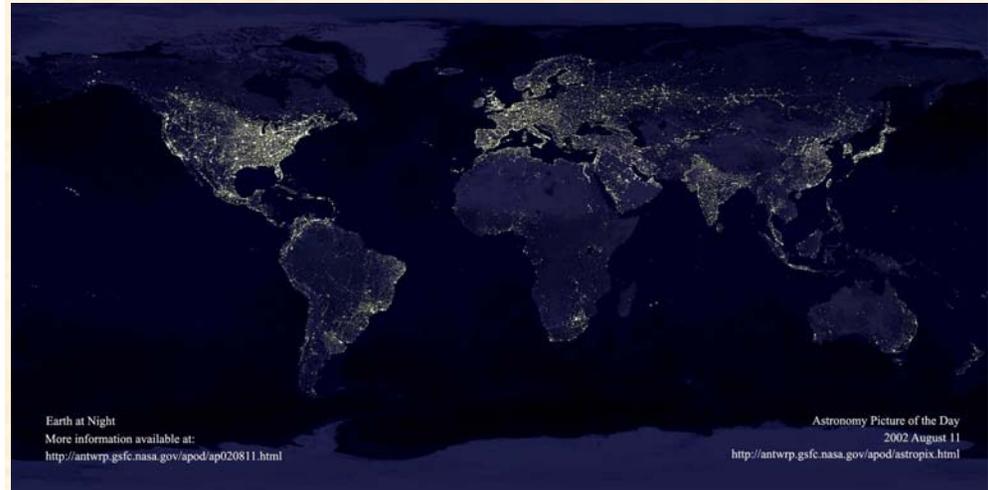
Figure 1. World Marketed Energy Consumption by Region, 2004-2030



Sources: 2004: Energy Information Administration (EIA), International Energy Annual 2004 (May-July 2005), web site [www.eia.doe.gov/iaa](http://www.eia.doe.gov/iaa). Projections: EIA, System for the Analysis of Global Energy Markets (2007).

OECD = Organization for Economic Cooperation and Development

## Earth's Night Lighting as Viewed From Space



Today the brightest areas are USA, Europe and Japan. Tomorrow Asia, particularly China and India, will be equally or more bright

**The Demand for Energy Is Expected to Outpace the Supply for the Foreseeable Future Creating Steadily Increasing Competition For Energy**

# There is now an urgency to achieve a reorientation in the way the US acquires, distributes and uses energy

- **Exploding demand for energy**
  - Involves production, distribution and consumption sectors
- **Vulnerability of energy supplies and distribution to terrorism and warfare**
- **Aging electric grid and pipeline infrastructure**
- **Increasing concentration of energy assets in the hands of problematic governments**
- **Growing willingness of these governments to use energy as a geopolitical weapon**
- **Evidence that climate change is accelerating**

# Awareness of energy issues has dramatically increased in past 2 years

**“Energy and the environment have emerged as among the most potent forces reshaping the global economy in the 21st century”**

**Council on Competitiveness (Sept., 2007)**

**“I would state unequivocally that energy security and the economic and environmental issues associated with it should be the most important topics of the 2008 Presidential election... Meeting this challenge of statesmanship will be the defining test of the next Presidency”\***

**Senator Richard Lugar, Senate Foreign Relations Committee, Former Chairman & Ranking Republican**

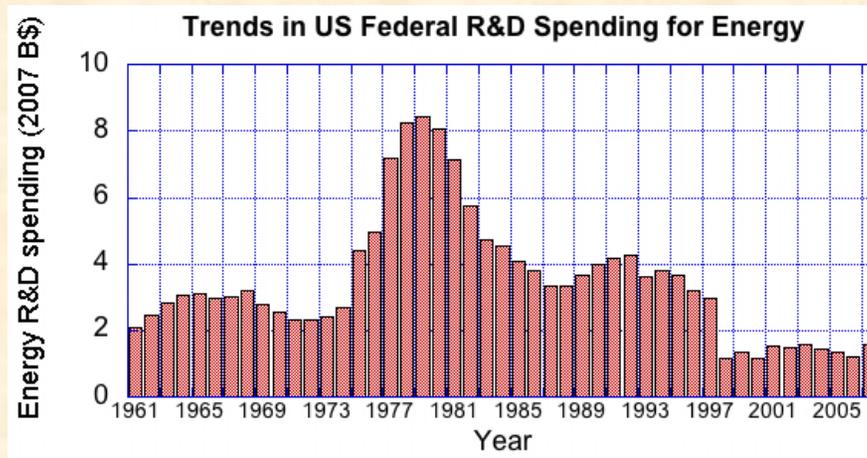
**\*Dec., 2007 speech at Brookings Institution on U.S. Energy Security and the 2008 Presidential Election**

# Technology is the Best Near Term Course of Action to Achieving Energy Assurance

- **The U.S. Public is Poised to Demand Energy Assurance**
- **Technology-Based Solutions Are the Most Viable Option for Achieving Energy Assurance on a Pace Needed to Supply US Demands**
  - They offer the best opportunity to balance Energy, National, Economic, and Environmental Security
  - They depend upon the existence of a strong U.S. science and technology program
  - They are completely in U.S. control
  - They engage a wide and diverse science, technology and production workforce
  - They address all energy sectors
  - They address production, distribution, and consumption
  - They fuel renewed growth and entrepreneurship
  - They are enabling; not defensive

# Current federal energy R&D funding is well below potential market value

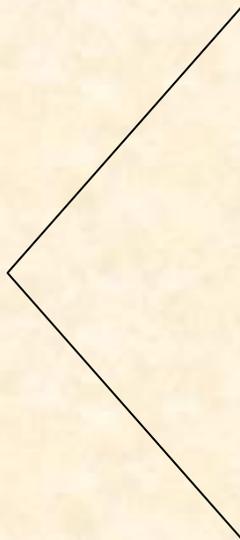
- **Current federal energy R&D funding is 0.15-0.4% of the US energy expenditures (depending on how energy R&D is defined)**
  - ~5x smaller than in 1980
  - 1% of US energy expenditures in 2007 would correspond to 10B\$/year energy R&D funding



# Success Model

The Essential Three Parts Are:

**Physical: Science  
and Technology**



**Virtual: Modeling and  
Computer Systems**

**Information, Command,  
& Control Systems**