

# Learning for Clean Energy Innovation

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# Energy is as important to modern society as food and water.

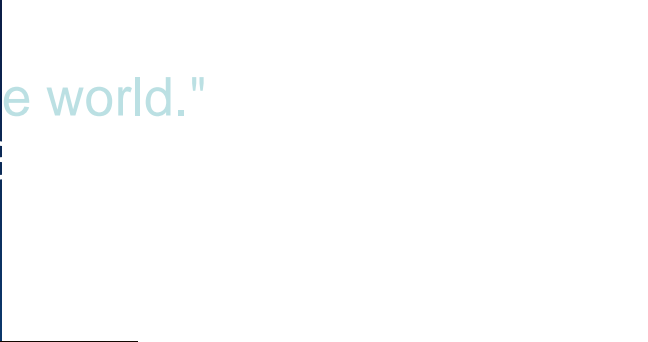
The current energy paradigm is losing its viability

*Securing our energy future is critical for the viability of our society – Time is of the essence and money and energy are in short supply.*

# Energy: Issues and Challenges

- ✓ *"Energy is the major input for overall socio-economic development."* C.R. Kamalanathan, Secretary, Ministry of Non-Conventional Energy Sources, Government of India.
- ✓ *"National security depends on energy security."* President George W. Bush.
- ✓ *"The Americans in this area are very much the villains of the piece. They've not gone along with Kyoto and yet they are unquestionably the largest polluter with 4% of the world's population and 25% of greenhouse gas emissions."* Sir Crispin Tickell, the former British ambassador to the UN.

# The Addiction


"Keeping America competitive requires affordable energy. And here we have a serious problem: , which is often imported from unstable parts of the world."

President George W. Bush, State of the Union Address.



PHOTO: EVAN VUCCI/AP

Oil executives in front of Congress

"Big Oil execs testified before the Senate Tuesday, saying high oil prices were largely out of their control and 

"The  large parts of the U.S. economy - like the  - like the  and the  sectors are  and the  control 

[http://money.cnn.com/2008/05/21/news/economy/oil\\_hearing/index.htm?cnn=yes](http://money.cnn.com/2008/05/21/news/economy/oil_hearing/index.htm?cnn=yes)  
5/6/2009

# The Addiction (and solution?)

1. Increase access to the Outer Continental Shelf (OCS). Experts believe that areas under leasing prohibitions on the OCS could produce about 18 billion barrels of oil. (that's two years of current US demand).
2. Tap into the extraordinary potential of oil shale.
3. Permit exploration in the Arctic National Wildlife Refuge (ANWR).
4. Expand and enhance our refinery capacity.

**These Proposals Will Take Years To Have Their Full Impact, But That Is No Excuse For Delay**

**For the long run, we are dealing with the demand for oil by promoting alternative energy technologies.**

**--President George W. Bush, June 18, 2008**

[www.whitehouse.gov](http://www.whitehouse.gov)

# Oil: Dealers and Users

## Have Oil (the dealers)

Saudi Arabia	26%
Iraq	11%
Kuwait	10%
Iran	9%
UAE	8%
Venezuela	6%
Russia	5%
Mexico	3%
Libya	3%
China	3%
Nigeria	2%
U.S.	2%

## Users (the addicted)

U.S.	25%
China	7.7%
Japan	6.5%
Russia	3.4%
Germany	3.2%
India	3.0%
Canada	2.8%
S. Korea	2.6%
Brazil	2.6%
France	2.4%
Mexico	2.4%
Italy	2.3%

**The U.S. uses more than the next 5 highest consuming nations combined and we import 70% of our oil.**

June 21, 2007

# Science Panel Finds Fault With Estimates of Coal Supply

By [MATTHEW L. WALD](#)

WASHINGTON, June 20 — The United States may not have nearly as much coal as is popularly believed, and mining the remaining resources may be more dangerous for workers and the environment than current operations, the [National Academy of Sciences](#) said in a report Wednesday.

With domestic production of oil, gas and uranium far below peaks, coal has been promoted by elected officials and energy experts as the only bright spot in the national fuel supply picture. But as Congress considers billions of dollars in aid for projects to make gasoline and diesel substitutes from coal, and to build coal-fired plants that would capture their own carbon emissions, the study said that estimates of coal reserves were unreliable.

“There is probably sufficient coal to meet the nation’s needs for more than 100 years at current rates of consumption,” the study said. “However, it is not possible to confirm the often-quoted assertion that there is a sufficient supply of coal for the next 250 years.”

The 250-year estimate was made in the 1970s and was based on the assumption that 25 percent of the coal that had been located was recoverable with current technology and at current prices, said one member of the study group, Edward S. Rubin, a professor of environmental engineering and science at [Carnegie Mellon University](#).

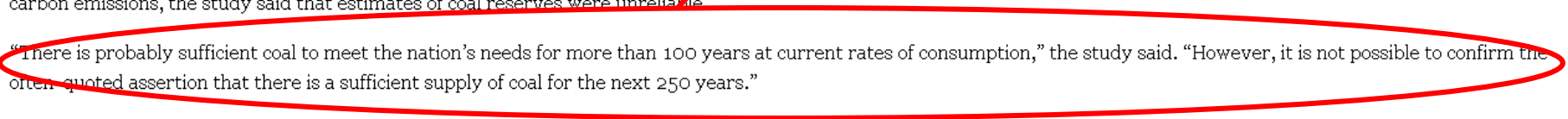
But he said that more recent studies by the [United States Geological Survey](#) showed that at least in some areas, only 5 percent of the coal was recoverable with today’s technology and at current prices. The 100-year forecast was based on current consumption rates, about 1.1 billion tons a year. By 2030, the rate of coal consumption could be 70 percent higher or 50 percent lower than it is now, the study found.

The impact of carbon constraints, if the government imposes them, are not clear, members of the study program said. The new report, which was requested by Congress at the urging of senators from two coal-producing states, [Arlen Specter](#) of Pennsylvania and [Robert C. Byrd](#) of West Virginia, raises the possibility that taxes on carbon dioxide emissions will sharply lower the demand for coal.

It also points out that mining will increasingly occur above or below seams that have already been excavated, raising questions about safety and the disruption of underground water flows.

The federal government spends hundreds of millions of dollars a year to research ways to use coal cleanly and tens of millions on miner safety. But the committee said more research was needed to find better ways to mine coal, to estimate reserves and to store carbon dioxide captured from plants. Carbon dioxide from burning fossil fuels is a major factor contributing to [climate change](#), scientists say.

“There is probably sufficient coal to meet the nation’s needs for more than 100 years at current levels of consumption...”



“However it is not possible to confirm the often-quoted assertion that there is a sufficient supply of coal for the next 250 years.” - National Academy of Sciences.

Home > News & Opinion > International News

## World has tapped just 18 percent of global oil supplies, Saudi executive says

By Associated Press  
Wednesday, September 13, 2006 - Updated 07:13 AM EST

VIENNA, Austria - The world has tapped only 18 percent of the total global supply of crude, a leading Saudi oil executive said Wednesday, challenging the notion that supplies are petering out.

Abdullah O. Jum'ah, president and CEO of the state-owned Saudi Arabian Oil Co., known better as Aramco, said the world has the potential of 4.5 trillion barrels in reserves - enough to power the globe at current levels of consumption for another 140 years.

Jum'ah challenged oil ministers and petroleum executives at an OPEC conference in Vienna to step up exploration "and leave the minimum amount of oil in the ground."

"The world has only consumed about 18 percent of its conventional potential," Jum'ah said, contending that should lay to rest fears that the world is in danger of being tapped out within a few decades.

Many experts estimate that the planet's recoverable oil resource is at least 3 trillion barrels and potentially more than 4 trillion barrels. If global consumption rises about 2 percent a year from today's levels of about 85 million barrels a day, they say, the low end of that range would only be enough to last until roughly 2070.

Rex W. Tillerson, the chairman of Exxon Mobil Corp., said world demand for oil will increase by 50 percent in the next decade.

"When nations threaten to stop this flow, it stops economic progress worldwide," Tillerson said.

Industry leaders have gathered this week to take stock of new challenges at the conference sponsored by the Organization of Petroleum Exporting Countries.

Earlier this week, the 11-nation cartel agreed to leave its current production target of 28 million barrels a day unchanged, but made clear it would keep close tabs on falling oil prices and consider a possible cut in its output quota before the end of the year.

Crude prices have tumbled to five-month lows and have dropped by more than \$12 a barrel since hitting record highs in mid-July. Analysts say a combination of ample supplies and an easing of political tensions such as the cessation of hostilities in Lebanon and progress in talks on Iran's suspect nuclear program have driven prices lower.

"When prices are high, passions can run high," Tillerson said. "Economic nationalism may gain in popularity" at the expense of developing global markets and the world economy, he said.

"The new era we face, like all of the previous ones, is not an era of easy oil - nor will it be an era of easy answers. But it can be an era of continued economic advancement," he said.

Jum'ah challenged explorationists to find enough new oil resources to add 1 trillion barrels to world reserves over the next 25 years, saying new technology and higher recovery rates would make it possible to hit that target.

Already, he noted, drilling is now going on as deep as 10,000 feet below the Gulf of Mexico and 7,000 to 8,000 feet elsewhere. Experts say a newly discovered petroleum pool beneath the Gulf of Mexico eventually could yield anywhere from 3 billion to 15 billion barrels.

### Related Articles

**International News**  
OPEC to hold production steady, take hard look at 'fear factors' driving oil markets

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Kidnapper's friend met captive, didn't know she was kidnapped years earlier

**International News**  
Young woman held for 8 years says she didn't miss out on much in captivity

**International News**  
Teen held for 8 years defends her captor as 'a part of my life'

More on:  
• Austria  
• Global Oil Supply  
• Saudi Arabia

### Today's Top Articles

Viewed	Emailed	Rated

Updated 8:22 PM

**International News**  
World has tapped just 18 percent of global oil supplies, Saudi executive says

**N.E. Patriots**  
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**Herald Columnists**  
Generations of good, evil collide on Southie streets

**More Inside Track**  
Spare us! Paper rips FOX25 for heartless homeless piece

**Boston Red Sox**  
Most Vexed Papi: Angry Ortiz clears the air with Jeter

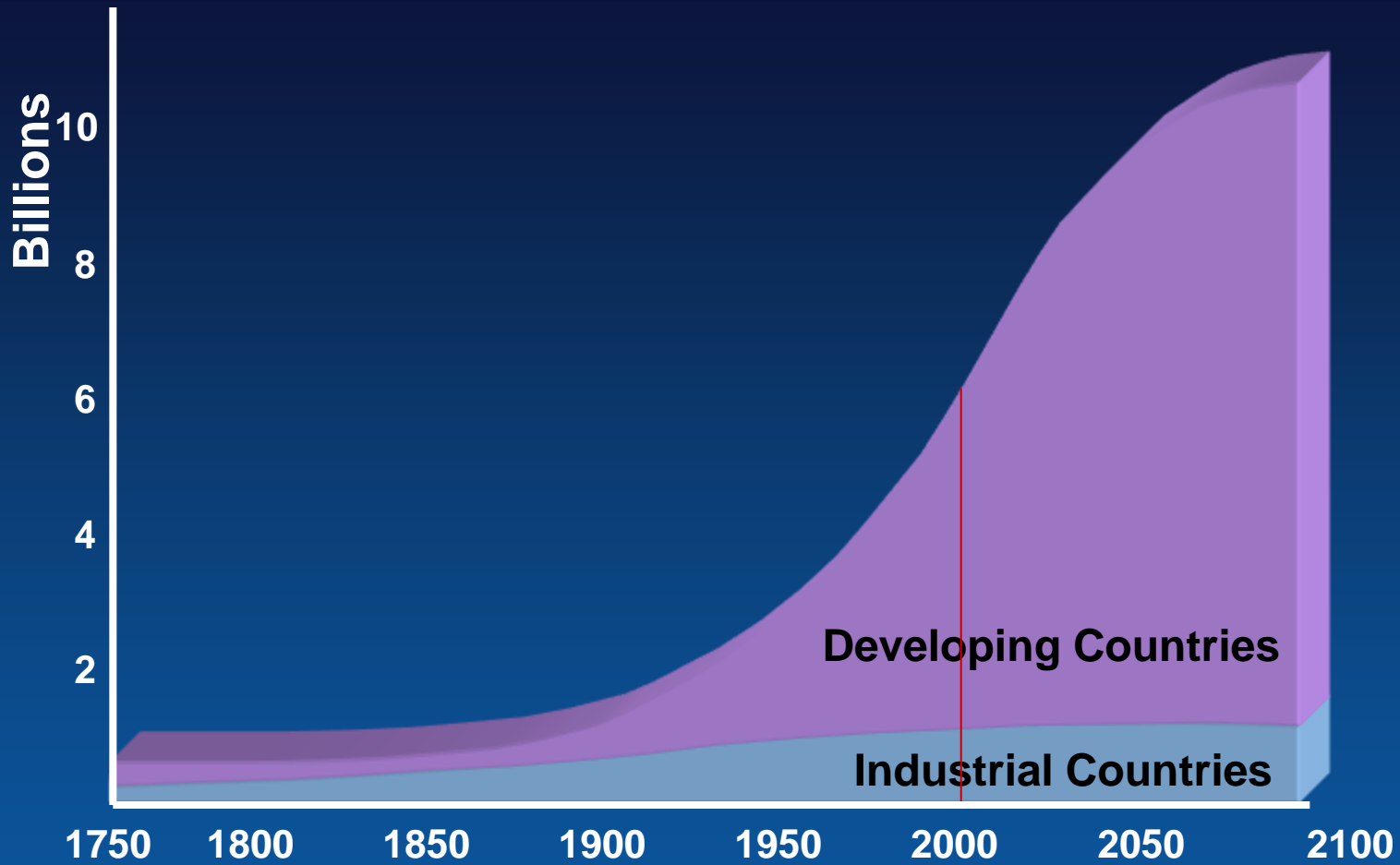
View the Herald Top Ten

“The world has tapped only 18% of the total global supply of crude,...”

“- enough to power the globe at of consu another

“If global consump about 2 p year...or to last un 2070.”

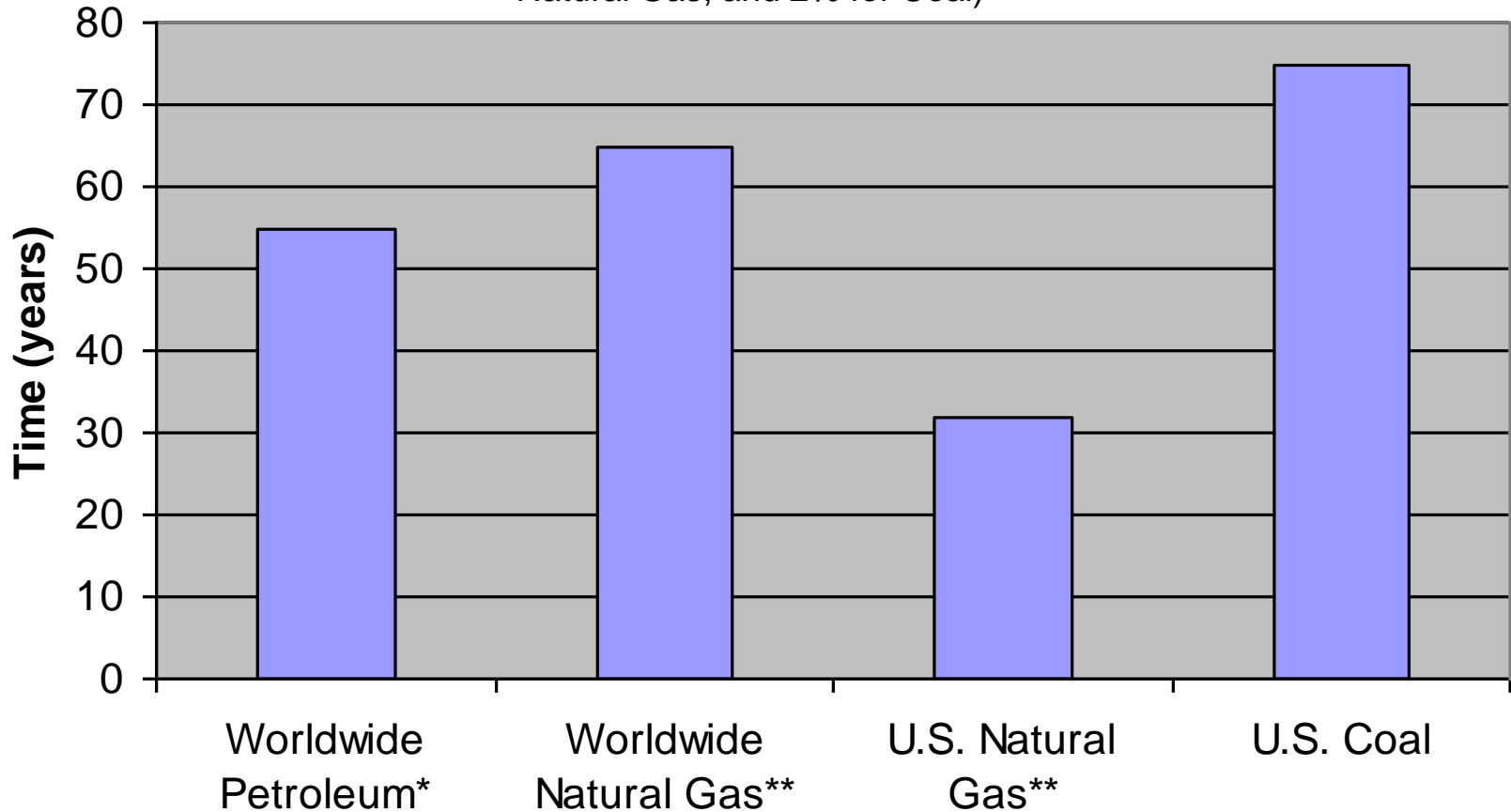
# World Population Growth 1750-2100



# Outlook for Fossil Fuel Resources

## Estimated Lifetimes of Fossil Fuel Resources

(Based on Projected Annual Growth Rates: 1% for Petroleum, 2.8% for Natural Gas, and 2% for Coal)



\*Estimated peak in world petroleum supply

\*\* Based on estimated natural gas resources

Source: Weisz, Physics Today, p. 47, July 2004

5/6/2009

# ENERGY CRISIS!

2.51  $\frac{9}{10}$

2.61  $\frac{9}{10}$

2.59  $\frac{9}{10}$

POWER AND LIGHT COMPANY  
GENERAL MAIL FACILITY  
VENICE FL 38218-0002

Before	Total Amount Past Due
2005	\$610.41

bring entire bill when paying in person.

Before	Total Amount Past Due
2005	\$610.41

**FINAL NOTICE**  
**Power is Turned Off**  
Please do the following:

Note

Amount

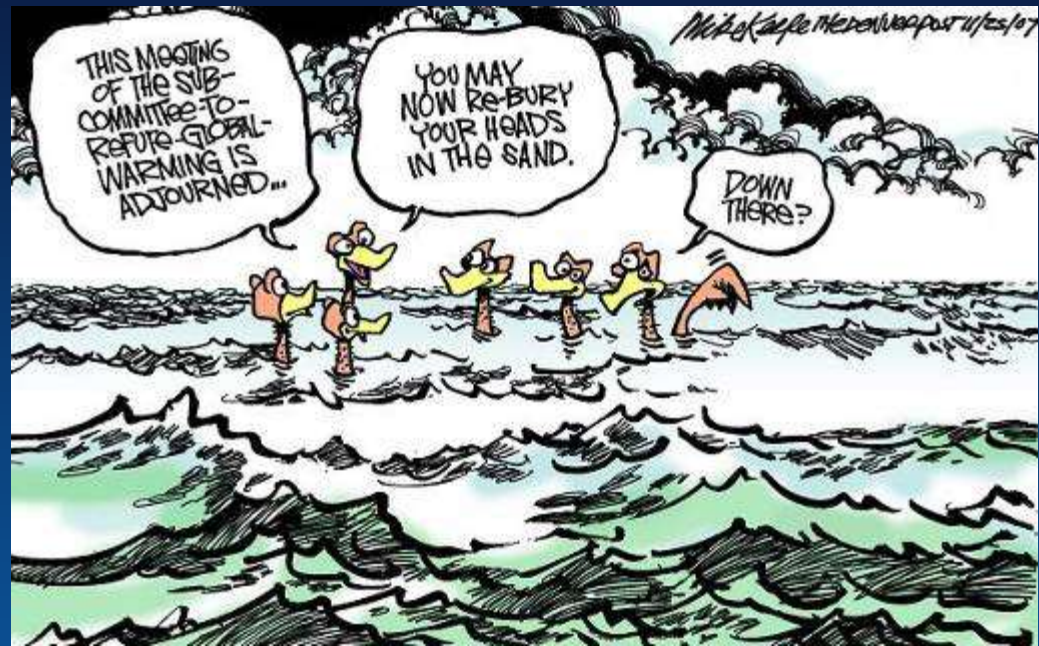
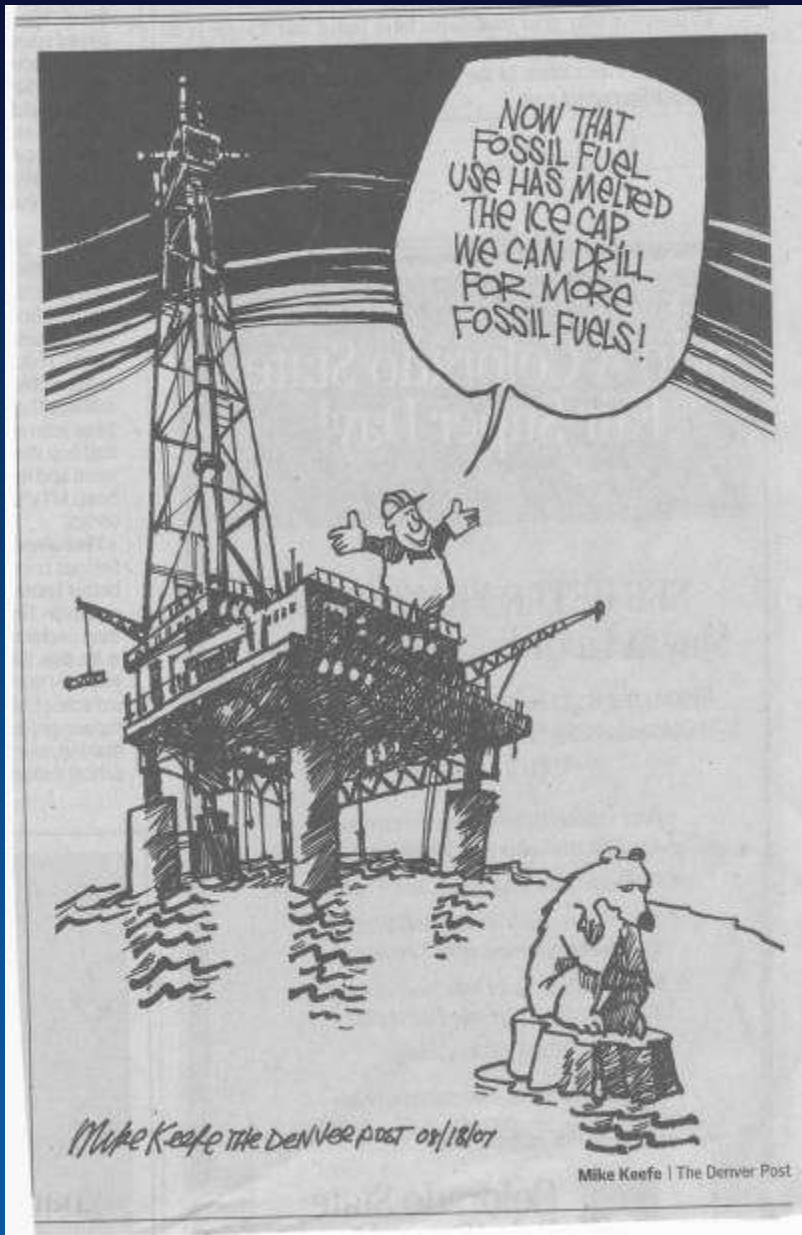
*Are you prepared  
for sky-rocketing utility bills?*



Source: World Resources 2000-2001

Time Magazine - 9 April 2001





“Houston, we have a  
problem.”



# Energy is as important to modern society as food and water.

The current energy paradigm is losing its viability

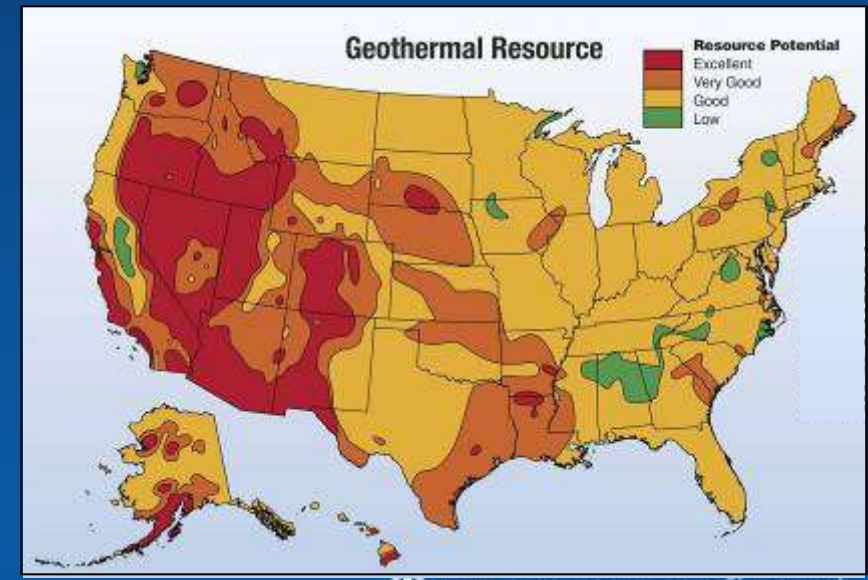
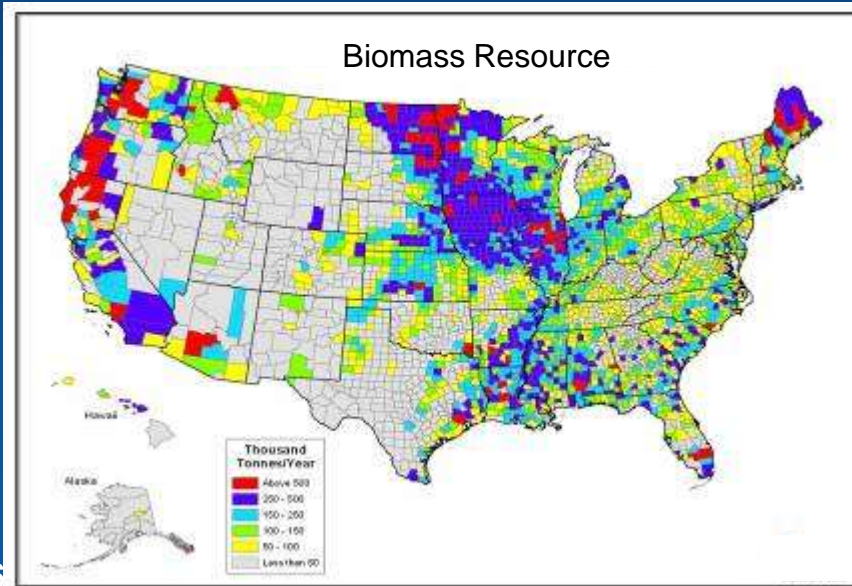
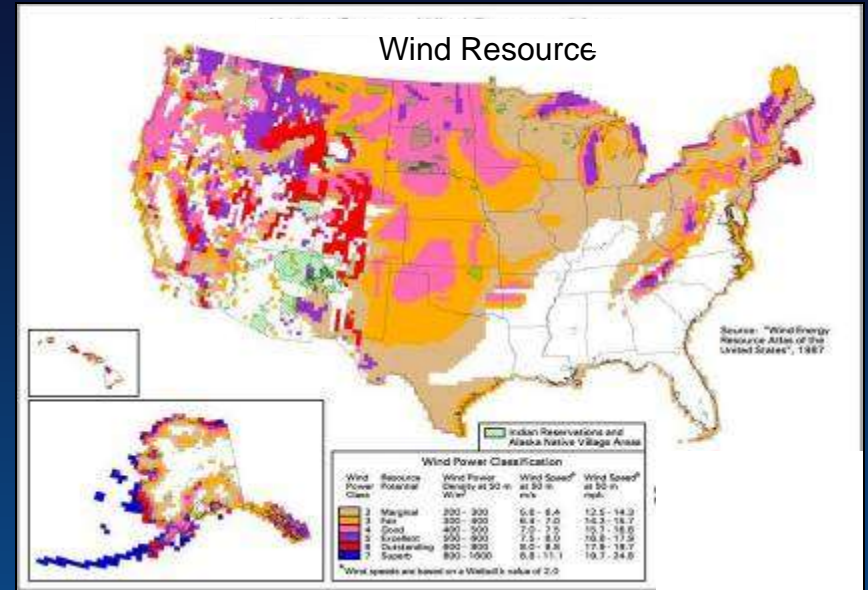
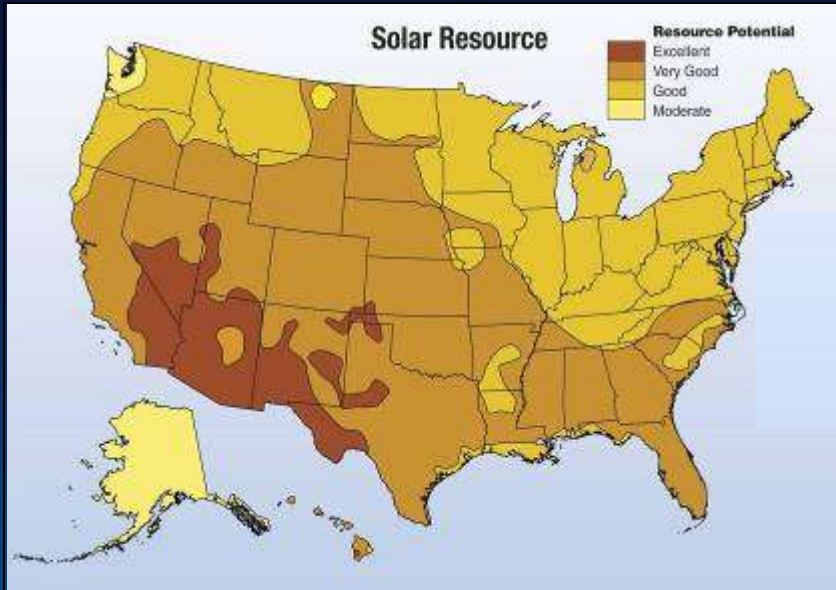
*What energy-producing technologies can be envisioned that will last for millennia and can be implemented in developing countries?*



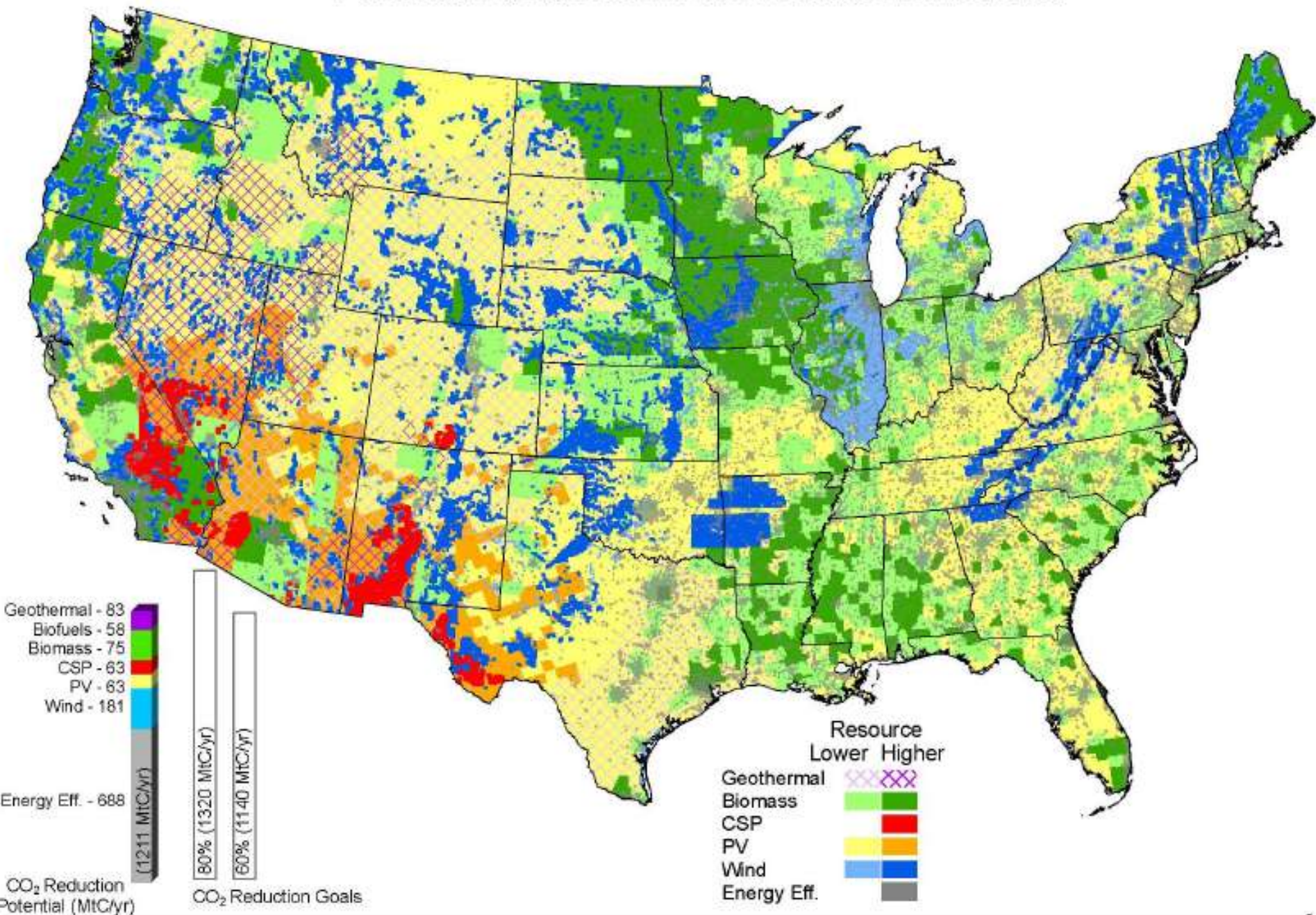
**“Houston, we have a solution!”**




# U.S. Sustainable Energy Resources



# Potential Reduction in U.S. Carbon Emissions



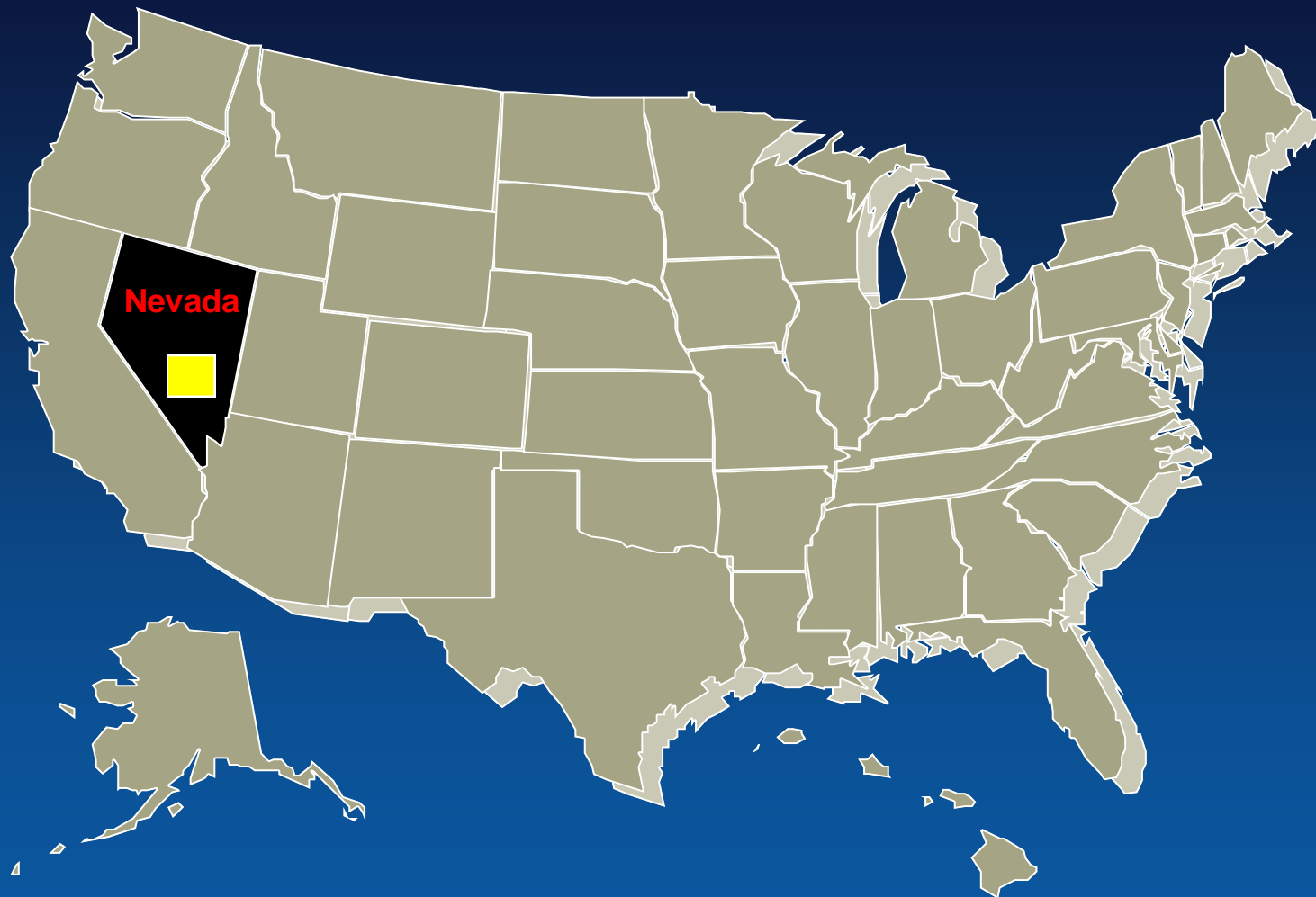


The Sun is the only natural resource that can keep up with human consumption... more solar energy hits the earth in 1 hour than all the energy the world consumes in a year.

Solar cells convert sunlight into electricity – but there is no good way to bottle and store up electricity.

The best way to store massive quantities of solar energy is to convert it into chemical fuel.

# Total Area Required for a Photovoltaic Power Plant to Produce the Total U.S. Annual Electrical Demand

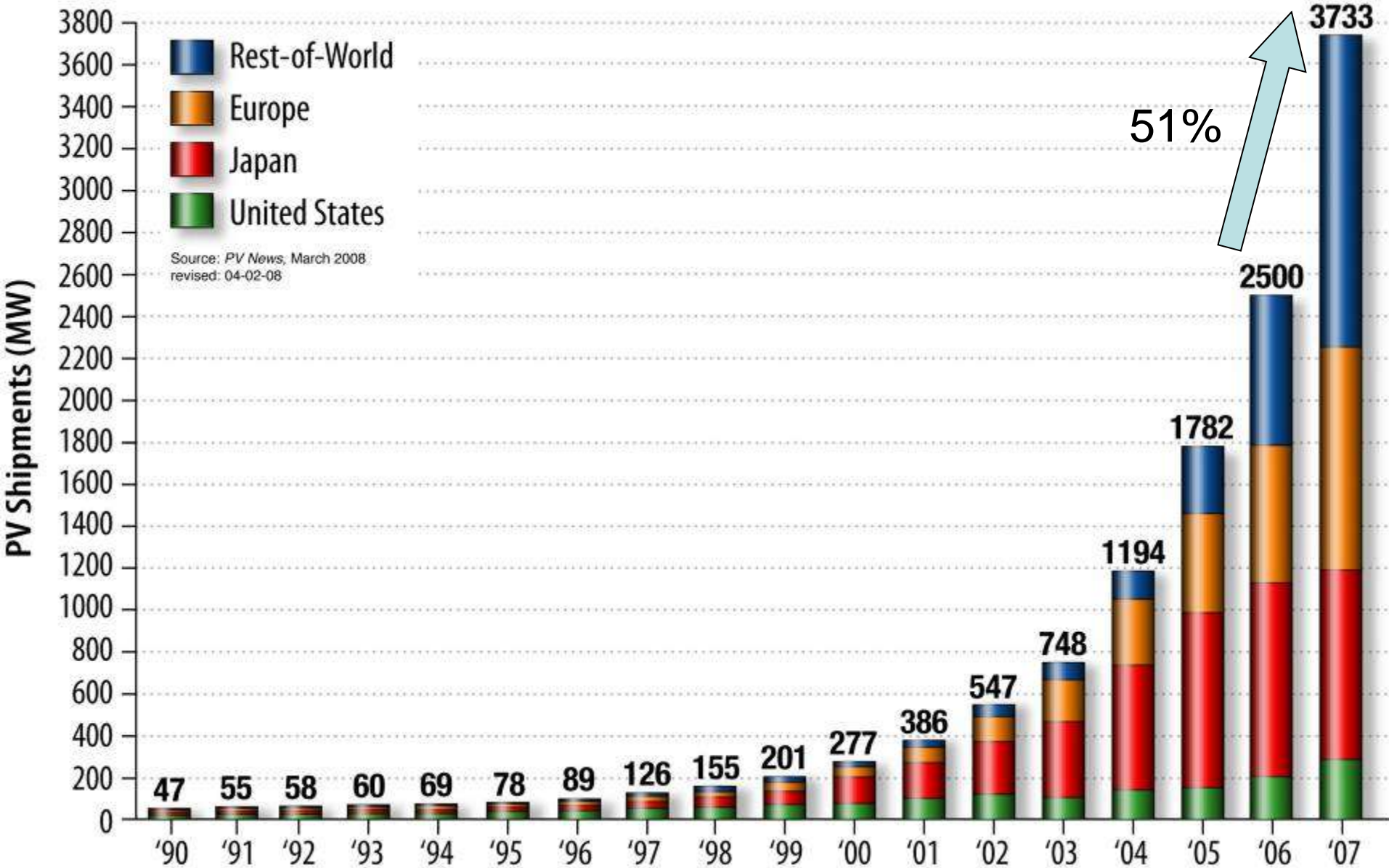


P109-G1055201

J. A. Turner, "A Realizable Renewable Energy Future", Science, 285, p 5428, (1999).

5/6/2009

# Global PV Cell Production (MWdc Peak)

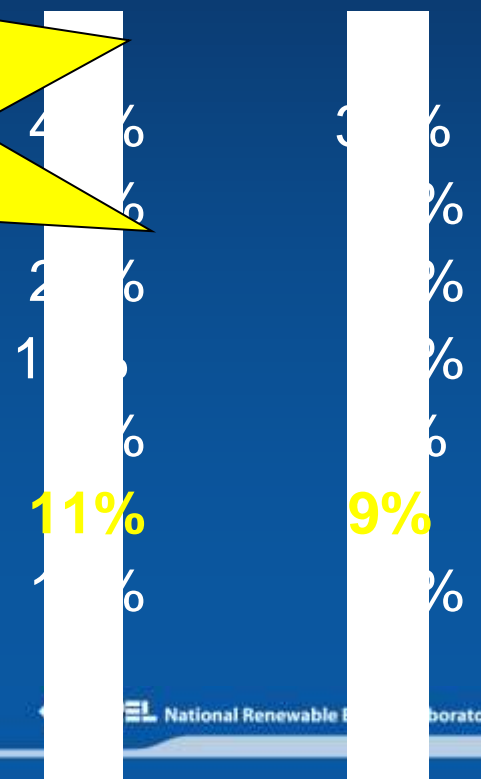


# Connecticut Opinion Poll

## Individual Actions to Address Climate Change

*What actions do you feel individuals can take to help reduce global warming? (multiple response)*

- Drive less
- Reduce energy use
- Buy hybrid vehicle
- Recycle
- Buy locally grown foods
- Use clean renewable energy**
- Don't know



### References

Nexus Market Research (April 2006). Commissioned by the Connecticut Clean Energy Fund.

# Learning for Clean Energy Innovations Program Objectives

- Provide resources to support educators and students in learning the Connecticut's 9th grade core science framework standards
- Increase the knowledge and awareness of **solar energy technology** and its benefits to society among students and educators
- Prepare for other clean renewable energy technologies such as wind energy and hydrogen fuels cells to be included in the program

# Learning for Clean Energy Innovation:

*A Professional Development Opportunity for CT Teachers*

- Integrating Solar Energy lessons into 9<sup>th</sup> grade Strand I- Energy Transformations
  - Inquiry Laboratory Activities on Solar Energy
  - Science, Technology and Society (STS) Projects on Solar Energy
- Professional Development : Workshops for Teachers (max. 100)
- Incorporate Clean Energy Communities' PV installation systems as an educational tool; and apply data monitoring system software as a teaching tool

# **Core Science Curriculum Framework:**

## **Alternative Energy Sources**

- Grade 9 – Strand I: Energy Transformations
  - Science and Technology in Society – How do science and technology affect the quality of our lives?
    - 9.3 Various sources of energy are used by humans and have advantages and disadvantages.
    - Alternative energy sources are being explored and used to address the disadvantages of using fossil and nuclear fuels
- D9. Describe the availability, current uses and environmental issues related to the use of hydrogen fuel cells, wind and solar energy to produce electricity.**

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# Clean Energy Communities Program



20% by 2010 Campaign  
Commitment to Clean Energy



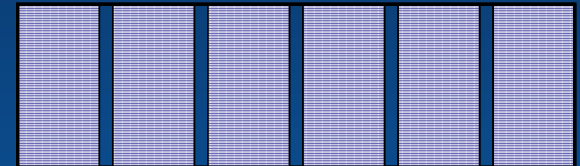
+

100 Sign-Ups in Your Town to the

**CTCleanEnergyOptions**

=

Free 1 kW Solar PV



# Learning for Clean Energy Innovation:

*A Professional Development Opportunity for CT Teachers*

- Integrating Solar Energy lessons into 9<sup>th</sup> grade Strand I- Energy Transformations

- [Redacted] on Solar Energy
- [Redacted] Projects on Solar Energy

- Professional Development Workshops for Teachers

- Incorporate Clean Energy Communities' [Redacted] systems as an educational tool and [Redacted] system software as [Redacted]

## 1. Common Ground High School. New Haven, CT.

### System Details:

- 2.0 kW Photovoltaics
- Module type: Sanyo HIP-200BA3
- Module power: 200 Watts
- Number of modules: 10
- Inverter: SMA Sunny Boy 2100
- Mounting system:
- Azimuth / Tilt: 172° / 32°
- Lat / Lon: 41°20'16.89"N / 72°57'30.31"W
- Solar Contractor: PV Squared
- Educational Display Type: Heliotronics Feynman™
- Educational Data Display: Internet & Real Time based on Sunviewer™ software



[Monitor site performance...](#)

# CT Clean Energy Community Program Linked PV Systems

## 2. EO Smith High School. Storrs Mansfield, CT.

### System Details:

- 3.0 kW Photovoltaics
- Module type: Sanyo HIP-200BA3
- Module power: 200 Watts
- Number of modules: 15
- Inverter: SMA Sunny Boy 3300U
- Mounting system: Direct Power and Water Ballasted Racks.
- Azimuth / Tilt: 150° / 25°
- Lat / Lon: 41°48'16.41"N / 72°14'38.75"W
- Solar Contractor: PV Squared
- Educational Display Type: Heliotronics Feynman™
- Educational Data Display: Internet & Real Time based on Sunviewer™ software



[Monitor site performance...](#)

## 3. Glastonbury High School. Glastonbury, CT.

### System Details:

- 4.0 kW Photovoltaics
- Module type: Sanyo HIP-200BA3
- Module power: 200 Watts
- Number of modules: 20
- Inverter: Fronius IG 4500 LV
- Mounting system: Direct Power and Water Ballasted Racks.
- Azimuth / Tilt:
- Lat / Lon: 41°42'09.21"N / 72°35'32.79"W
- Solar Contractor: PV Squared
- Educational Display Type: Heliotronics Feynman™
- Educational Data Display: Internet & Real Time based on Sunviewer™ software



[Monitor site performance...](#)

# QUESTIONS



IT'S REAL, IT'S HERE, IT'S WORKING

# Thank You!