

**EAS 375**

# **Great Issues**

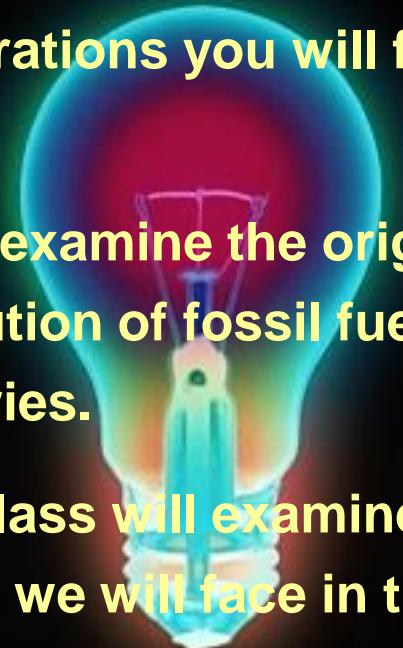
## **Fossil Fuels, Energy and Society**

**A look at the world of energy and its role in  
society during the 21<sup>st</sup> century**



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# **Class Structure**

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- 1. Examination of science and the scientific method, with an emphasis towards ethical considerations you will face when dealing with emotional issues.**
  - 2. The second section will examine the origin, history of development, processing, and distribution of fossil fuels during the latter half of the 19th and 20th centuries.**
  - 3. The last section of the class will examine how to deal with the impending energy crisis we will face in the 21<sup>th</sup> century and the options that we may use to mitigate the energy crisis.**

# Selected Teaching Resources

## Readings:

I will place a series of articles on Blackboard to supplement the PowerPoint lectures which will aid you in preparation for the exams.

## Text for class:

Hofmesiter, John 2010, Why We Hate the Oil Companies, Macmillan, 249p.

## Optional Texts:

The following books are optional for any students that desires additional information about fossil fuels and alternative energy sources. These texts can be purchased on Amazon.com, Half.com, Abebooks.com, or other internet booksellers at discount prices.

Freese, B. 2003, Coal, A Human History, Penguin Books, 304p.

Moore, Patrick, 2010. Confessions of a Greenpeace Dropout, Making of a Sensible Environmentalist. Beatty Street Pub., 378p.

# **Internet Resources**



**A number of links will be placed on Blackboard, which will be excellent sources of basic energy information and statistics.**

**Pertinent papers will also be placed on Blackboard.**

**Topical papers, such as how gasoline stations set their prices or important news stories that occur during the semester will also be posted on Blackboard and discussed in class.**

# Webpage Resources

The screenshot shows the homepage of the Energy Information Administration (EIA). The header features the EIA logo and the text "Energy Information Administration" and "Official Energy Statistics from the U.S. Government". A search bar and a "Glossary" link are also present. Below the header is a row of five images representing different energy sectors: Petroleum (oil pump), International (nuclear power plant), Electricity (power lines), Natural Gas (gas pump), and Coal (city skyline).

The main content area is organized into several sections:

- Petroleum**: Crude oil, gasoline, heating oil, diesel, propane, jet fuel, and other petroleum based products...
- Natural Gas**: Exploration and reserves, storage, imports and exports, production, prices, sales...
- Electricity**: Sales, revenue and prices, power plants, fuel use, stocks, generation, trade, demand & emissions...
- Coal**: Reserves, production, prices, employment and productivity, distribution, stocks, imports and exports...
- Nuclear**: Uranium fuel, nuclear reactors, generation, spent fuel...
- Renewable & Alternative Fuels**: Includes hydropower, solar, wind, geothermal,
- International**: Country energy information, detailed and overviews...
- Forecasts & Analyses**: Monthly and yearly energy forecasts, analyses of energy topics, financial analyses, Congressional reports...
- State & U.S. Historical Data Overview**: Monthly and yearly energy statistics allow for comparison across all fuels and sectors...
- Households, Buildings & Industry**: Energy use in homes, commercial buildings, manufacturing and transportation...
- Environment**: Greenhouse gas data, voluntary reporting, electric power plant emissions...
- Energy Kid's Page**: Classroom projects, games, energy basics...

On the right side, there is a sidebar with the following sections:

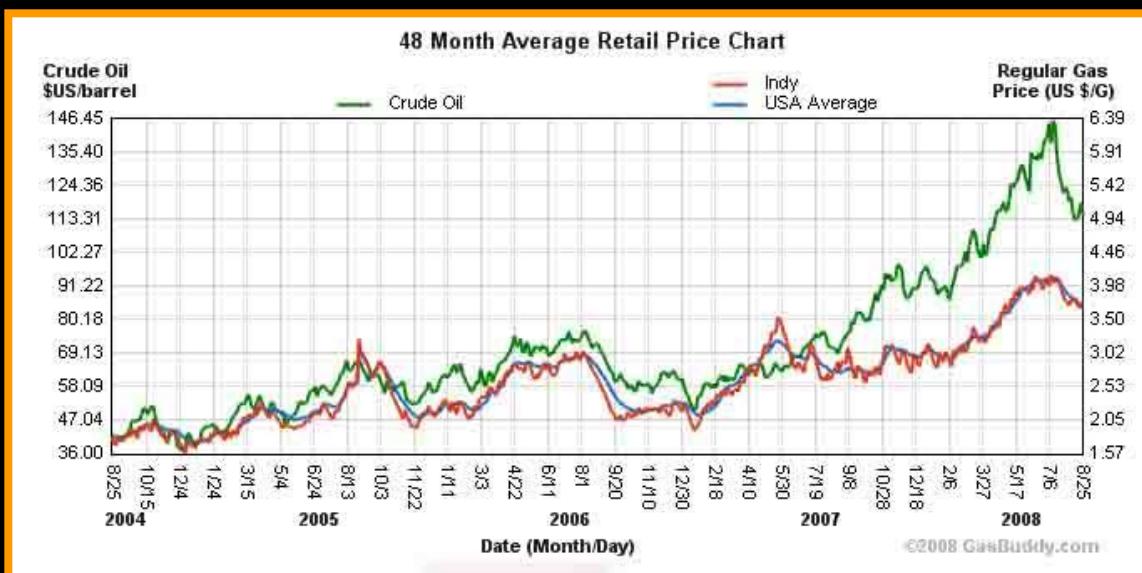
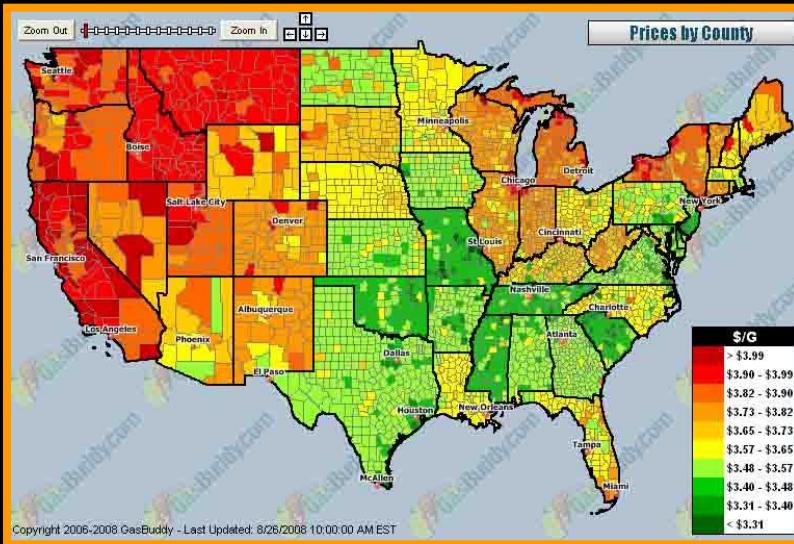
- Latest Data**
  - Crude Spot Price** - 12/13/2007  
\$92.35/bbl wk chg: +2.10 yr chg: +31.01
  - Retail Gasoline Price** - 12/10/2007  
\$3.000/gal wk chg: -0.061 yr chg: +0.707
- 2008 Energy Conference**  
Attend EIA's annual energy conference.
- Announcements & News**
  - What's New
  - Press Releases
  - Presentations, Testimony, Events
  - Upcoming Reports
- Publications & Reports**
  - Gasoline & Diesel Fuel Update
  - This Week in Petroleum
  - Annual Energy Review
  - Heating Oil & Propane Update
  - more...
- References**
  - Energy Basics 101
  - Survey Forms
  - Frequently Asked Questions

At the bottom of the sidebar, there are links to **Fedstats**, **USA.gov**, and **Dept of Energy**.

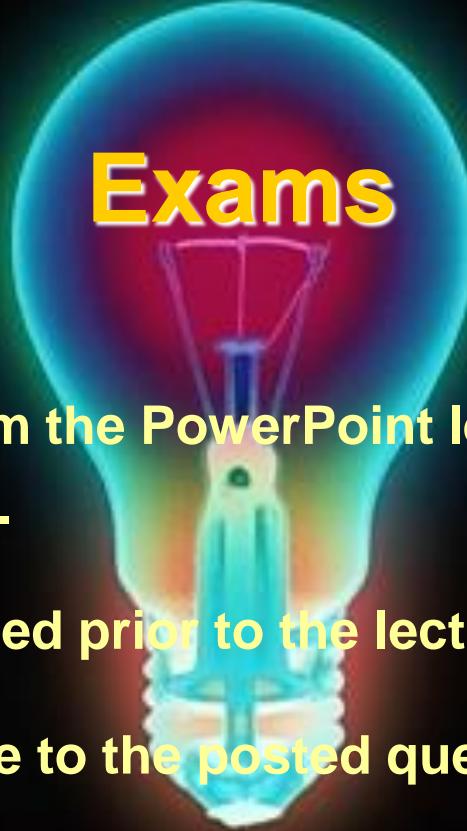
**Best website to check recent and historical energy data.**

**Do not accept data on the internet blindly, check basic data sites such as EIA.**

# Gasbuddy



Gasoline price temperature map August 27, 2008



# **Exams**

**A list of questions from the PowerPoint lectures will be posted before each lecture.**

**Questions will be posted prior to the lectures.**

**Exam questions will be to the posted questions.**

**The only exception will be two generalized questions on each exam from Hofmeister's book, Why We Hate the Oil Companies.**

# **Weekly News Summaries**

**Each week a short summary of a current news story regarding energy that you have read using Google Alert will be submitted to me.**

**There will be a total of 14 weekly news items, which will be due on Friday of each week.**

**The first news item will be due on Friday, January 11<sup>th</sup>. The weekly news item will be submitted electronically using the Blackboard Assignments Page.**

**No news summaries will be accepted after the due date.**

**Enter the date at the top of the page along with the source citation and website.**

**Each summary is worth 10 points for a total 120 points.**

**Go to Google Advance Search and type in - oil, gasoline, production, energy, environment to be received by you once a day or once a week.**

# Exams & Quizzes

Two exams (100 pts each) 300

Weekly news summaries (10 pts. each)  $\frac{120}{420}$

Final grade will be based on a strict percentage:

A - 100 to 90% - 420 to 378 pts

B - 89 to 80% - 377 to 336 pts

C - 79 to 70% - 335 to 294 pts

D - 69 to 65% - 293 to 252 pts

F - less than 65%

# **Power Point Lectures**

The Power Point lectures will be available on **Blackboard** prior to the lecture.

The purpose of putting the Power Point lectures on **Blackboard** is allow you to print off a hard copy prior to class time to use as notes.

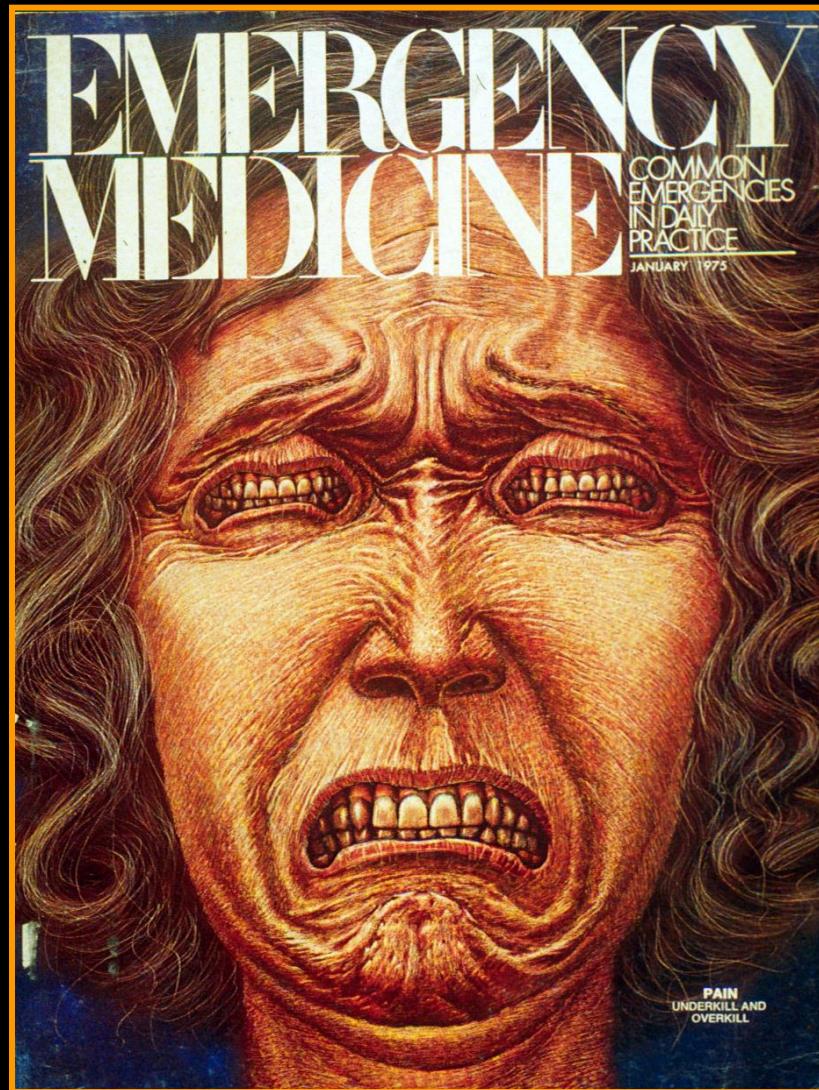
Do not assume that the Power Point lectures are all you need in order to pass the class. Your Attendance is required. Not everything or depth of coverage of lecture material is included in the PowerPoint lectures. You are responsible for anything and everything that I bring up during class, including any relevant stories.

I constantly update my lectures, sometimes just before class time. If the lecture has been changed after the initial posting, I will note the change by the addition of a letter following the lecture number.

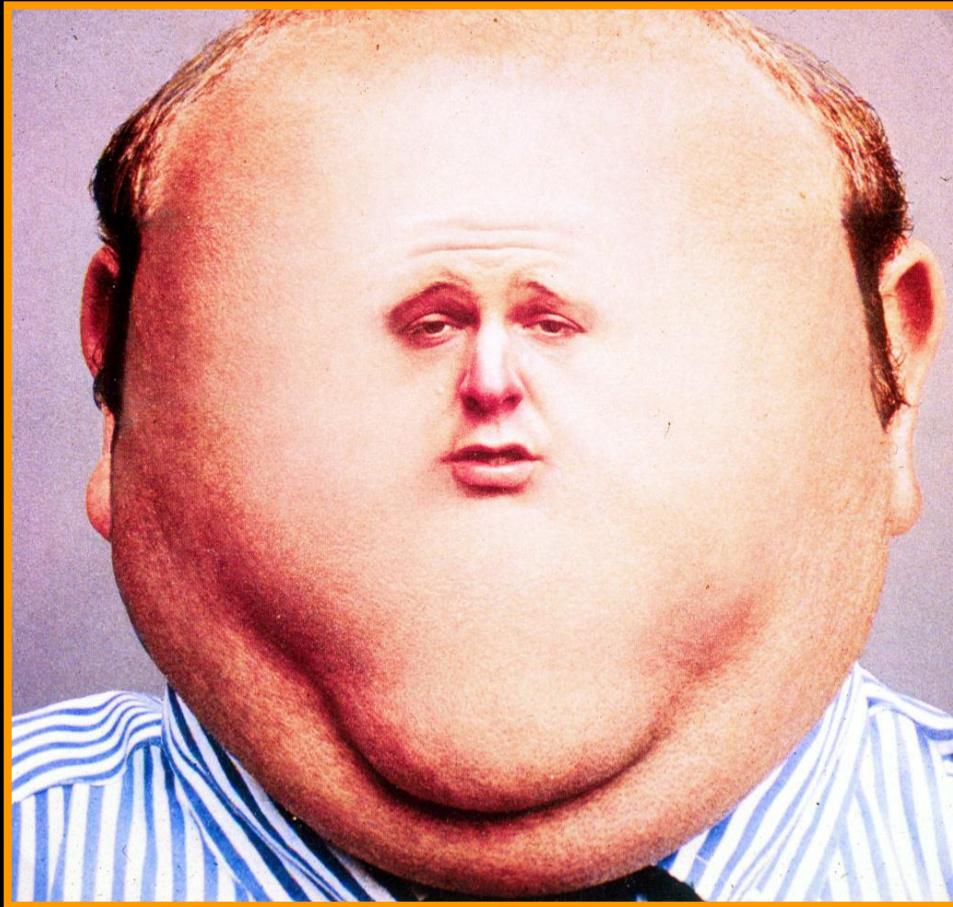
# Don't be Afraid to Ask Questions.



I just can't do it! Yes you can!



# **Test Time: too many facts**

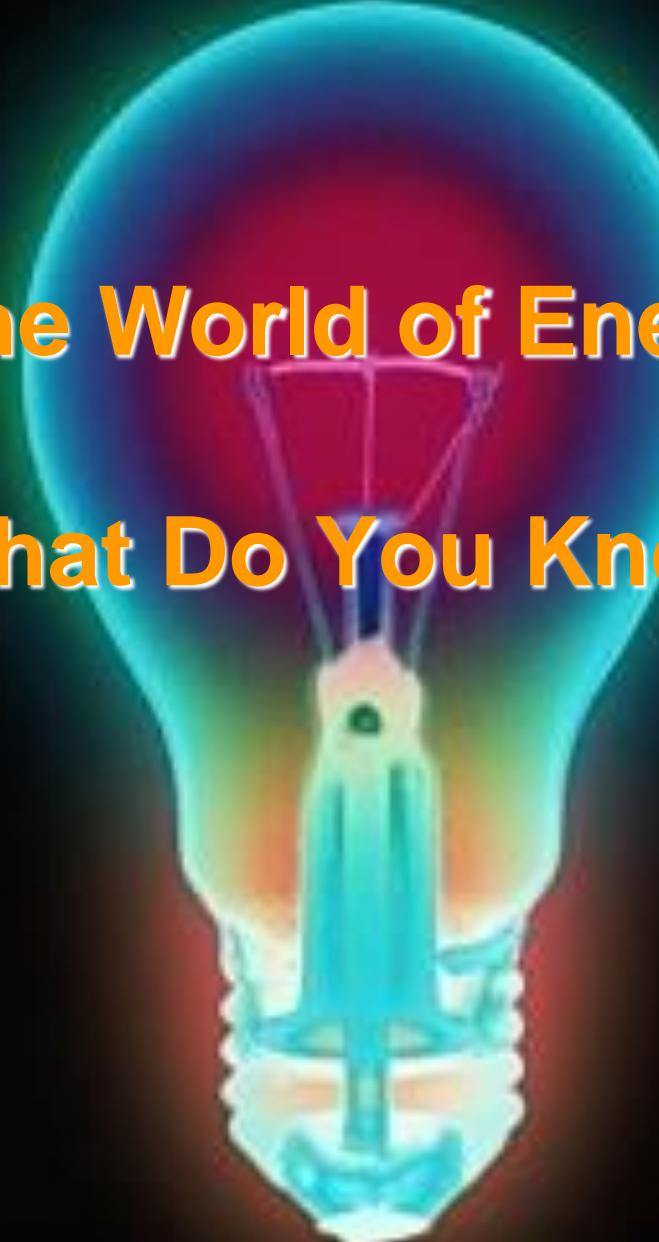


**If you don't study, don't worry,  
there's always a job out there for you.**





**Wonders of 21<sup>st</sup> century  
are based on cheap and  
abundant energy during  
the 20<sup>th</sup> century**



# The World of Energy

## What Do You Know?

# **Crude Oil Imports Oct 08**

## **(Million barrels a day)**

**U.S. production** **4,645 (35%)\***

<b>Total Imports</b>	<b>13,217</b>
Canada	2,587
Saudi Arabia	1,487
Mexico	1,433
Venezuela	1,162
Nigeria	979
 <b>Total OPEC imports</b>	 <b>5,888</b>
 <b>Total daily crude oil used</b>	 <b>17,683</b>
 <b>Total U.S. oil consumption</b>	 <b>19,643</b>

\* Domestic production has increased to ~45% in 2012

# Crude Oil & Retail Price of Gasoline 2002 - 2008



# Gasoline Prices from 2006 - 2012



Arrows – October prices

A photograph of a large cargo ship sailing on a dark, choppy sea. The ship's hull is visible on the left, and its deck with several shipping containers is on the right. The sky above is filled with heavy, dark clouds, suggesting an approaching storm.

# **The Approaching Global Energy Crisis**

## **“A Perfect Storm”**

# **The Perfect Storm**

A photograph of a dramatic, cloudy sky over a beach. In the foreground, a wooden pier extends from the right side of the frame towards the left, ending in a small building. The beach is sandy and appears relatively empty. The sky is filled with heavy, dark clouds, suggesting an approaching storm.

**Continued population growth.**

**A peak in global oil production.**

**Declining per capita food production.**

**Climate change, pollution, habitat destruction, loss of bio-diversity.**

**Unsustainable levels of debt.**

**International political instability.**

# **Why Now?**

A photograph of a coastal scene under a dramatic, cloudy sky. In the foreground, a paved walkway or pier extends from the bottom right towards the center. The ocean is visible on the left, and the horizon line is in the middle distance.

**Most segments of human society are based on “growth.”**

**God forbid - “no growth” or “worse negative growth.”**

# **Growth**

**What do we mean by growth?**

**Expansion of supply and demand of products that forms the foundation of our society.**

**Rates of growth:**

**Rapidly increasing growth**

**Steady or sustained growth**

**Is it possible to have unlimited growth? No!**

# **Growth in Biologic Terms**

**Individuals or population growth are characterized by a “growth phase”, during which early development is followed by cessation of growth or very slight additional growth.**

**Growth phase can not be a permanent state.**

**Populations will quickly overshoot and collapse when the limits of its environment is exceeded.**

# **Thomas Malthus (1766-1834)**



**Published “Essay on the Principle of Populations”**

**“The power of population is so superior to the power of  
the earth to produce subsistence for man, that  
premature death must in some shape or other visit the  
human race”**

# **Population Growth of Societies as Viewed by Malthus**

**"Resources (food) increases in an arithmetic ratio"**

**"Population, when unchecked, increase in a geometric ratio"**

**"Life is a struggle, only the fittest survive"**

# **Malthus Viewed the “Struggle for Survival” as :**

**Nation against nation**

**Competition for resources will lead to:**

**War**

**Famine**

**Disease**

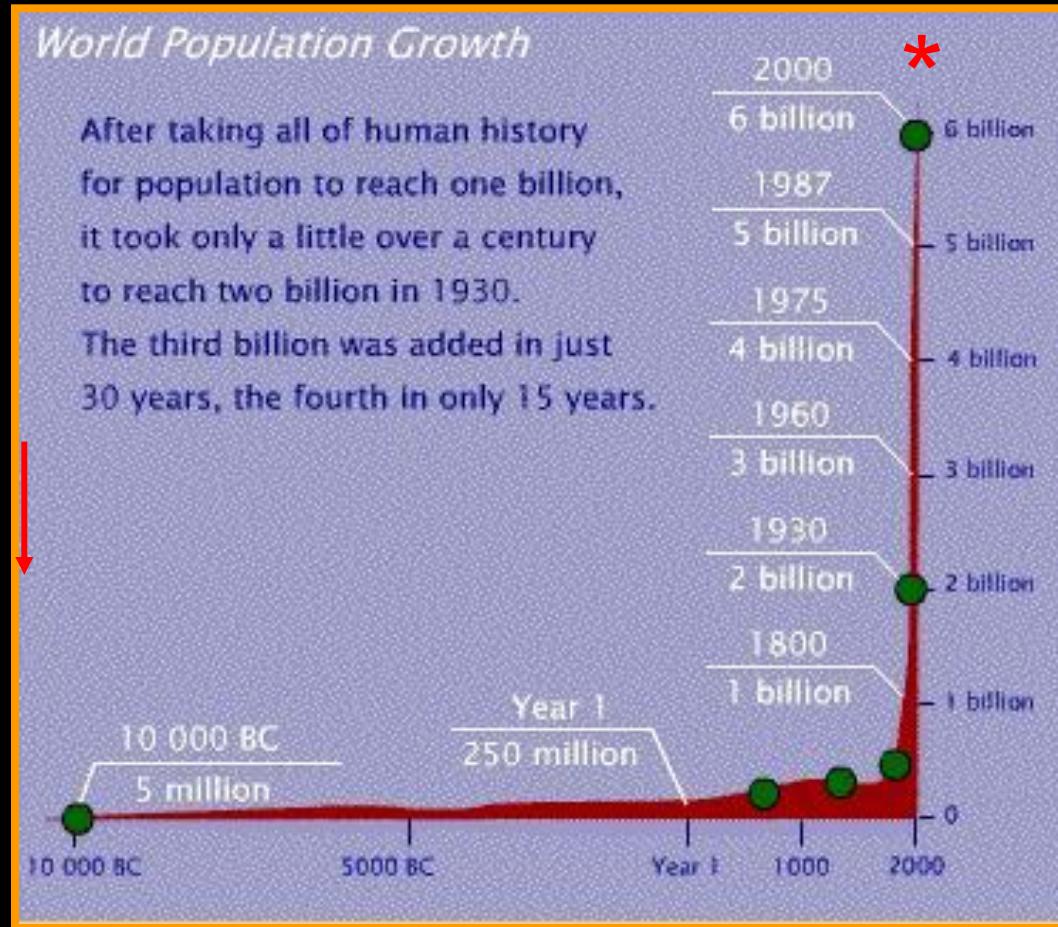
**Only the most powerful (strongest) nations will survive**



**Basis of the Impending “Perfect  
Storm”**

**Unrestrained population  
Growth!**

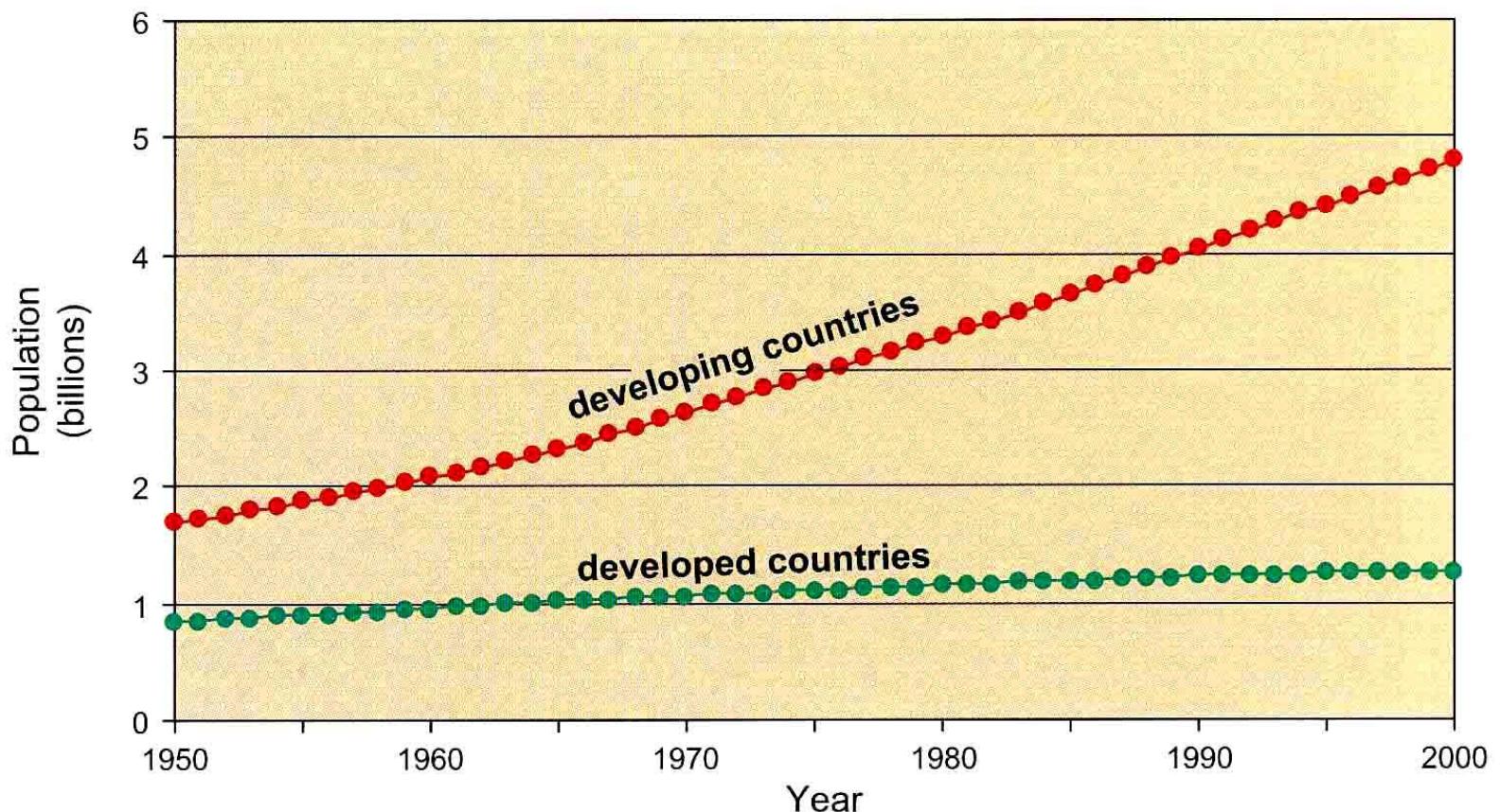
# Present Day Growth of the Earth's Population



\* 2011 – Population 7 billion

# Population Growth

## Developed vs Developing Countries



# **Why Has the Earth's Population Growth Defied Malthusian Principles?**

**The key to our unchecked population growth has been cheap and abundant energy - oil and coal**

# **Fossil Fuels Pervade Every Aspect of Our Society**

**Transportation**

**Food production**

**Products used in our everyday activities**

**Production of electricity**

# **Food Production**

**Energy has greatly increased our food supply:**

**Oil-powered machinery**

**Mechanization of planting and harvesting**

**Production of synthetic fertilizers**

**Production of electricity used in irrigation and pumping water from underground reservoirs**

# **Oil & Food Production**

## **Petroleum Derived Products have Greatly Increased Food Supply**

**Oil-powered transportation enables us to carry resources from where they are abundant to where they are scarce (in some cases 1000's of miles).**

**We can build cities in the middle of deserts and other hostile environments where people would normally not reside.**

# **Defying Malthusian Principles**

**Synthetic products such as plastics (made from oil) have supplanted some natural resources.**

**“Information age” has allowed us to manage our growth and anticipate and/or avoid potential growth limiting problems.**

**Technology and science has reduced our exposure to diseases and helped us prevent or limit epidemics.**

**Limited modification of our environment can reduce the affects of climatic events.**

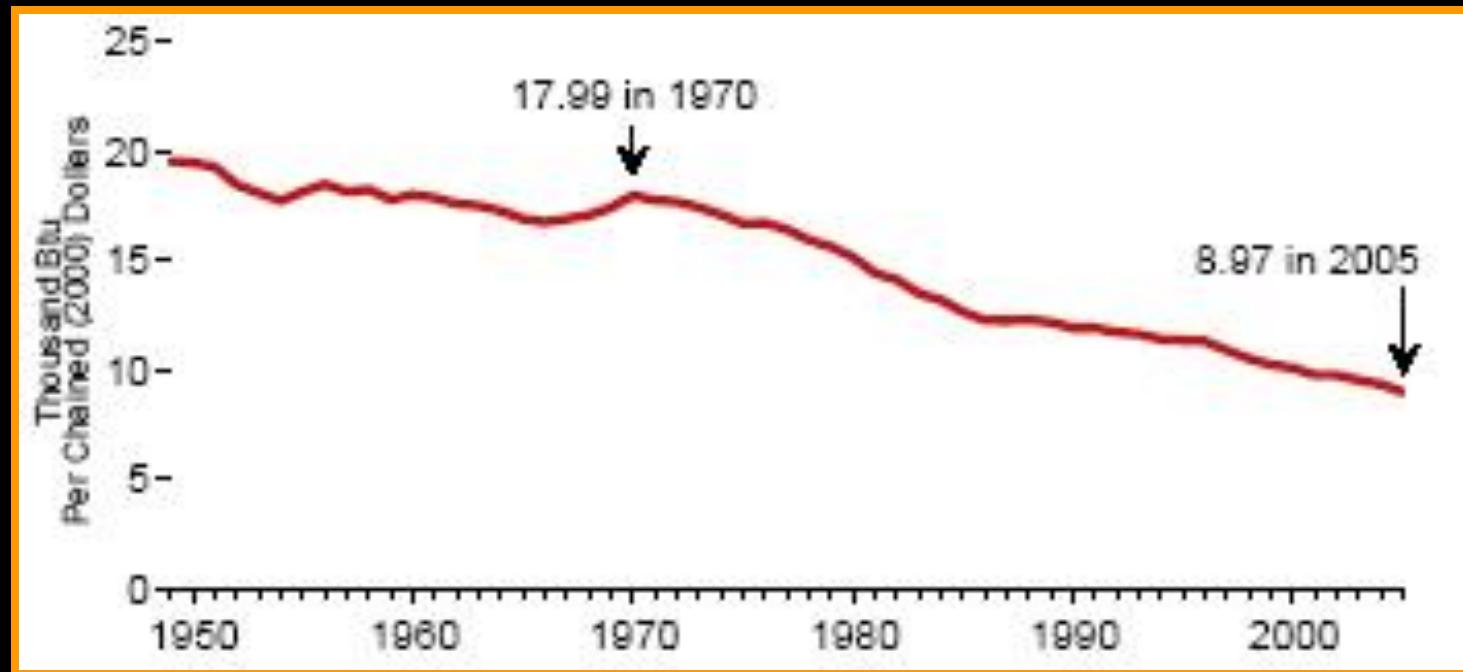
# Javons's Paradox



Williams Stanley Javons, 1866

**Noted that the technological progress that increased efficiency will increase (not decrease) the rate of consumption of that resource.**

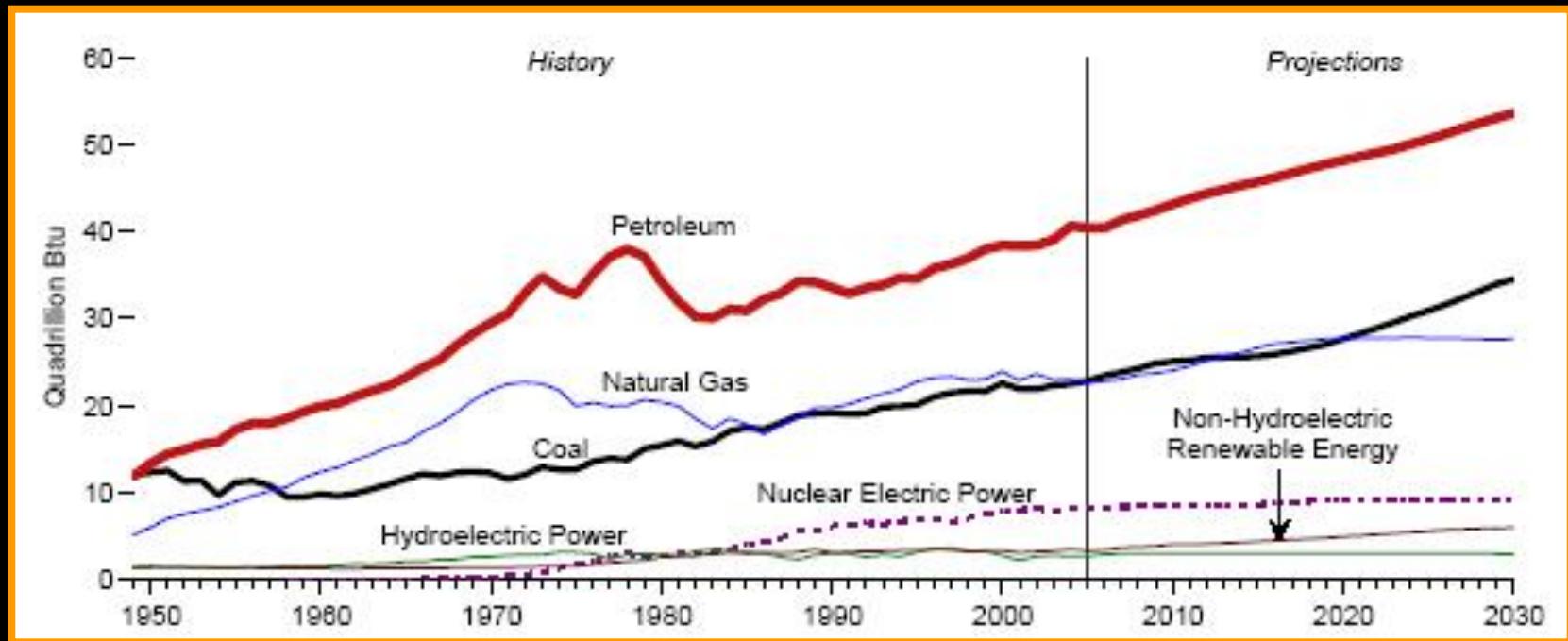
# **Energy Used per Real Dollar of Gross Domestic Product**



**Technology has made our energy usage much more efficient.**

**We can produce more using less energy.**

# Energy Consumption & Outlook 1949-2030



If we can produce more for less energy.

We can produce even more with the energy we've saved!

# **The Source of Energy**

## **There In Lies the Problem**

Sources of Energy:

- **Fossil resources:** oil, gas, coal
- **Renewable resources:** water, wind, solar power, biofuels

# Fossil Fuels

- **Good:**

- Abundant

- Contain high energy per volume of fuel (**energy density**)

- Relatively easy to acquire

- **Bad:**

- Polluting

- Environmentally damaging

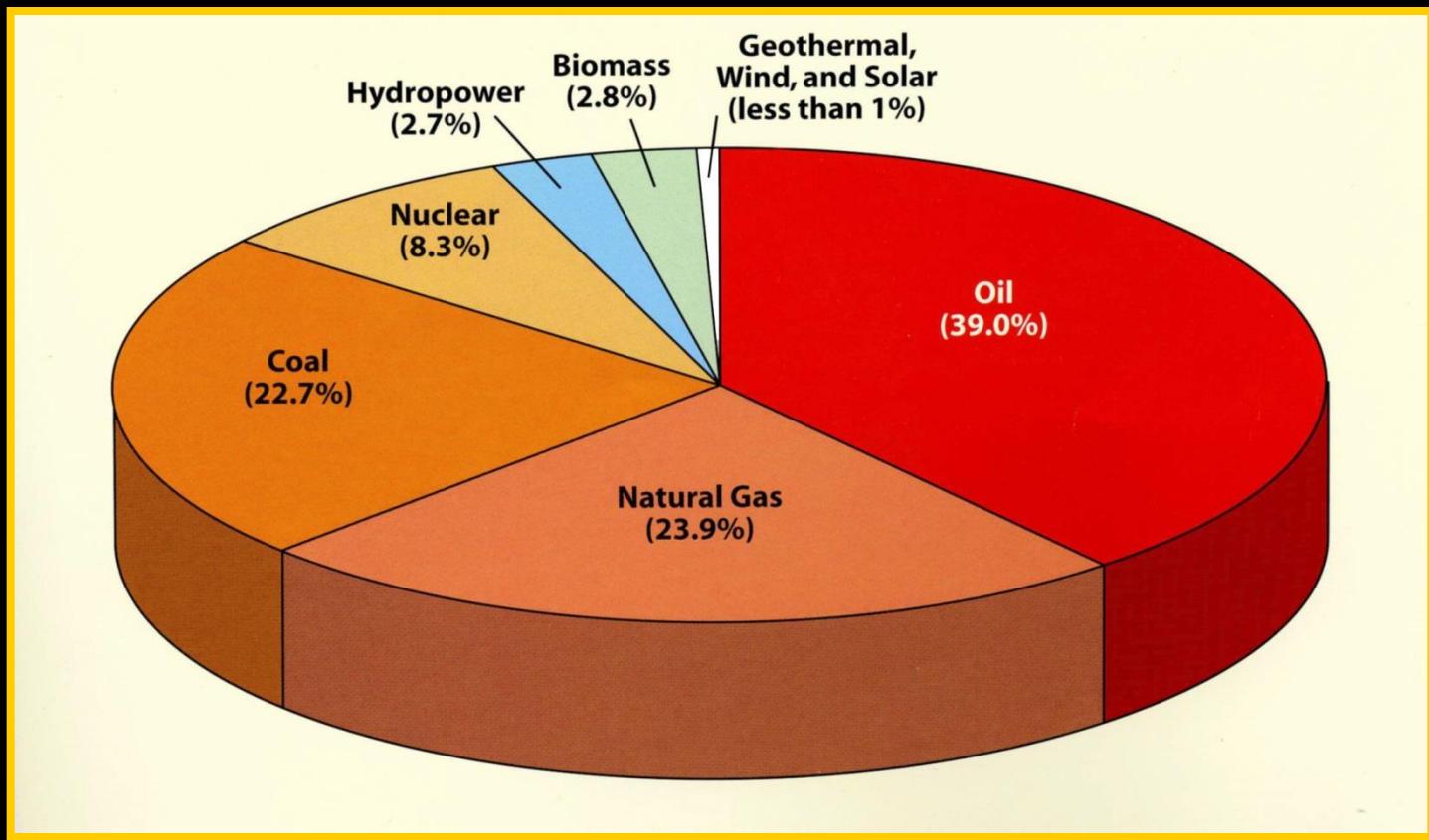
- Limited (**RUNNING OUT**)

- Have allowed us to deceive ourselves about unlimited growth

# **Renewable Fuel Resources**

- **Good:**
  - Renewable**
  - Non-polluting**
  - Generally not environmentally damaging**
- **Bad:**
  - Not enough to supply our energy needs at present (~7%)**
  - Some considered renewable ecstatically unacceptable (NIMBY)**
  - Can be locally environmentally disruptive**

# U.S. Energy Usage



# **Conventional Wisdom About Energy Growth**

**Growth in oil demand is slowing down.**

**New technology will reduce costs and continue the discovery of greater supplies of oil.**

**Supply: glut of oil just ahead.**

# **Conventional Wisdom about Oil Supplies & Use is Wrong!**

Demand grew (1995-2004 – 12.5 million bbl/d).

Demand for oil in the U.S. in 2008 – 22 million bbl/d\*

Exploration and development costs have soared.

New oil discoveries have dwindled and become smaller resulting in not being able to keep up with demand.

New technological inventions have “found new oil”, but have accelerated the decline of oil reserves - superstraw effect.

\*

# **Conventional Wisdom about Oil Supplies & Use May Not Be Totally Wrong!**

**While global demand continues to increase.**

**Demand in developed countries is moderating because of an economic slowdown and increased fuel efficiencies mandates.**

**Demand for oil in the U.S. in 2012 ~19.7 million bbl/d.**

**New technologies have altered the prevailing energy paradigm.**

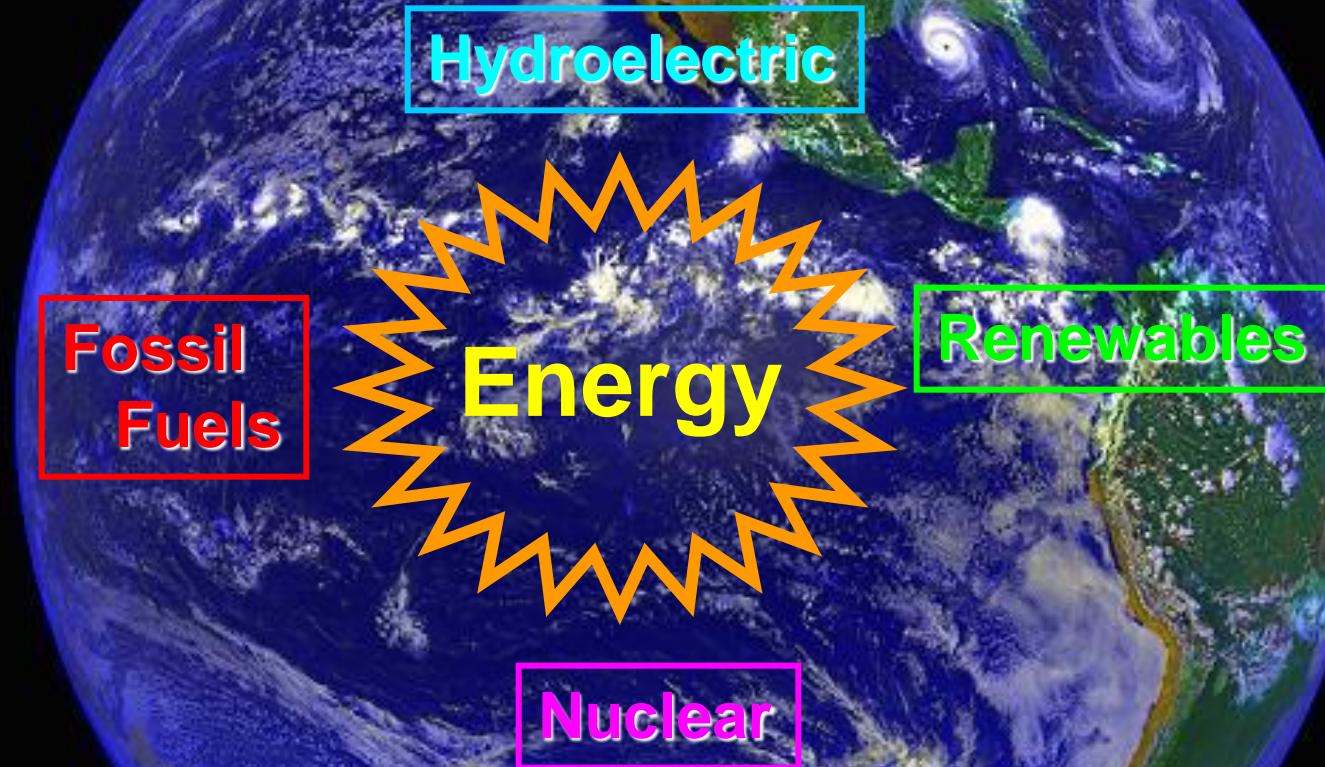
**Geopolitics.**

# **Can we continue to defy Malthusian principles?**

**Demand for energy will continue to increase.**

**All energy sources are increasing in both financial and environmental costs!**

# World Energy Sources



# **Energy**

## **World of Misunderstandings & Misconceptions**

**Energy and society are very complex subjects.**

**Does not lend itself to 30 second sound bites.**

**We have a love/hate relationship with the energy industry.**

**The history of the energy industry has without doubt contributed to the public's mistrust.**

**The public does not understand how the energy industry works or the limitations the energy industry faces in supplying the energy we use everyday.**

# **The World of Energy is Difficult to Understand**

**Exploration, production, and refining are based on sound scientific and engineering principles.**

**Distribution, marketing, and investing are not based on easily defined principles.**

**The energy industry is frequently driven by greed and politics which makes it exceedingly difficult to understand, predict trends, and frequently defies all logic.**

# **Keys to Understanding the Energy Crisis**

## **1. History and structure of the energy industry:**

**Understanding geology, formation, and concentration of fossil fuel resources in economic deposits.**

**Evaluating the size of energy resources.**

**Understanding factors that govern usage and depletion of the resources.**

**Limitations that the energy industries face when supplying the energy we have come to expect and depend on for our daily activities.**

# **Keys to Understanding the Energy Crisis**

## **2. Economic factors:**

**Economic factors that govern the production, distribution, and marketing of energy resources.**

**Economic factors control the utilization of the energy resources: rate of return on investment.**

**Production of energy must provide an acceptable monetary return to the investors (dividends).**

# **Federal Government Energy Programs are Highly Partisan & Dysfunctional**

## **3. Time:**

**Political time: Two, and four year cycles (next election)**

**Energy time: Decadal cycles (long term planning and building)**

# **Keys to Understanding the Energy Crisis**

## **4. Political factors that affect the development, production, and utilization of petroleum resources:**

**Role of special interest groups: campaign contributions and voter blocks**

**Keeping the voters happy (posturing, pandering)**

**Hoping to avoid blame for future crises by not facing facts (plausible deniability).**

**Politicians have a low opinion of the intellect of the voters**

# **Keys to Understanding the Energy Crisis**

## **5. Role of the media:**

**24/7 media coverage news is having an impact greater than most people realize.**

**Large majority of reporters and writers have little or no knowledge of science or how science works.**

**Media tend to be alarmists .**

**If it does not fit in a 30 second sound bite, there is a good chance it will not be covered.**

**If an idea does not conform to the media's bias, it will be frequently ignored.**

**The media and politicians have little to no respect for the general public intelligence = you and me!**

# **Keys to Understanding the Energy Crisis**

## **6. Political agendas:**

**Recognize that nearly everyone who writes about the energy industry has an agenda.**

**Many believe that “their solution” is the only one that will “save our society.”**

**Recognize that many of the solutions proposed by alarmists are impractical and do a disservice to mitigate the impending energy crisis.**

# **There will be a Energy Crisis Within the Next Several Decades:**

**Understand that the energy crisis is far greater than global warming because it is imminent and the consequences may be catastrophic.**

**Recognize that “we” are the ultimate cause of the impending energy crisis and “we” are the ones that must solve it.**

**Recognize that the energy crisis is multi-faceted.**

**There is no simple solution. A thorough solution will require new and innovative thinking.**

**We need to recognize:**

**There are no easy paths to the ultimate solution  
of the energy crisis.**

**Mitigation of the energy crisis will require both  
short and long term solutions.**

**Compromise and acceptance of some of the  
solutions will be difficult.**

# **Your Role**

**Recognize that each of you will play a role in solving the energy crisis:**

- 1. Developing innovative technologies and scientific breakthroughs.**
- 2. Advising our political leaders.**
- 3. Most important - Explaining the nature of the energy crisis and solutions to the general public.**