

The above is the opening preamble to the Earth Charter. It is a global consensus statement on ethics and values for a sustainable future. Developed over a period of ten years, in what has been called the most extensive global consultation process ever associated with an international declaration, the Earth Charter has been formally endorsed by over 2,500 organizations, including global institutions such as UNESCO and the World Conservation Union (IUCN). The effort was spearheaded by Mikhail Gorbachev and Maurice Strong (Secretary-General of the Rio Summit).

Here's another bit of interesting commentary:

“It has often been said that, if the human species fails to make a go of it here on the Earth, some other species will take over the running. In the sense of developing intelligence this is not correct. We have or soon will have, exhausted the necessary physical prerequisites so far as this planet is concerned. With coal gone, oil gone, high-grade metallic ores gone, no species however competent can make the long climb from primitive conditions to high-level technology. This is a one-shot affair. If we fail, this planetary system fails so far as intelligence is concerned. The same will be true of other planetary systems. On each of them there will be one chance, and one chance only.” (Sir Fred Hoyle, 1964)

# Sustainability or Apocalypse

The Coming “Perfect Storm” of  
*Problems and Opportunities* in the  
critical decades ahead.

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*“ It's tough to make predictions,  
especially about the future ”*



Many spiritual gurus, yogis, and philosophers have long speculated about the future. Here's a quote from one of my favorite yogis.

If you don't recognize who this is from, here's a picture of him deep in concentration.

It's Yogi Berra of course.

But sometimes aspects of the future can be easily predicted, because

***“The future is already here. It's just not widely distributed yet.”***

# Apocalyptic thinking

- The end of the world as we know it
  - Common among religious fundamentalist
- Growing interest in secular apocalyptic thinking too







This has been common in fundamentalist religious communities for a while. In some sense it has been common in religious organizations throughout history. In christianity it dates back to the years just after the death of Jesus, when his followers expected the world to end within their lifetime. Islam has a related view surrounding the return of the 12<sup>th</sup> Imam.

There is now a growing “secular apocalyptic” theme based on a convergence of problems. Human society as we know it is about to fall apart. Climate change and peak oil are some of the most factors, but there are more.

## Optimism About Major New Positive Trends and Opportunities

“Another world is not only possible,  
she is on her way.  
On a quiet day,  
I can hear her breathing.”

-Arundhati Roy, an Indian writer and activist



On the other hand, there is also a strain of growing optimism that things are finally changing for the better after a long struggle.

The cold war ended peacefully.

India and Pakistan did not have a nuclear war

US did not invade Iran.

There is a committed and growing global movement towards peace and justice; On Feb 15th 2003, one month before the start of the Iraq war, more than 10 million people world wide went out into the streets to oppose the upcoming start of that war. This happened with no central planning, no charismatic leader, and no budget. It was a phenomena unprecedented in the human experience.

There is a feeling that something new is happening.

Some ***BIG*** changes are coming...  
and we don't know what to make of  
them yet.

- Explosive growth in technology
- Globalization
- Changes to social structures and organizations

There is also this third trend, somewhat in the middle of the other two. We'll also talk about some of these.

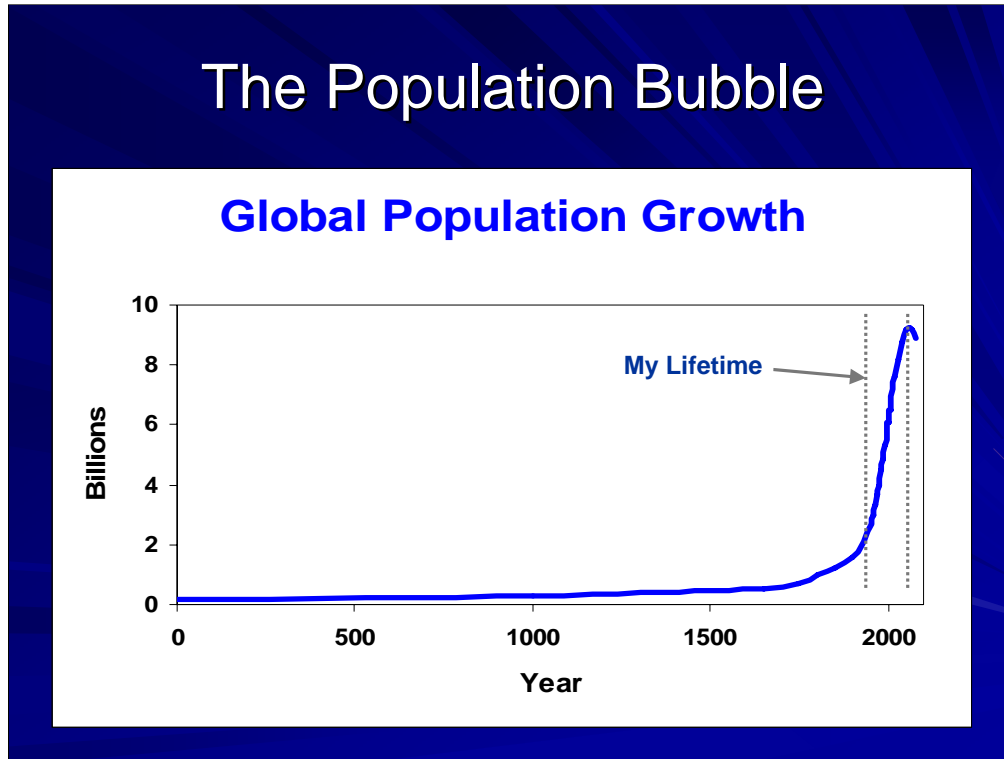
## Overview of Today's Story

We will be facing an unprecedented rate of change in the next few decades

- A “perfect storm” of problems, both nationally and as a global society
- A rate of technological change far greater than people expect
- New emerging opportunities to make some major positive changes

The next three to four decades will be some of the most exciting and important in the history of the human race

We could usher in a era of sustainability or major turmoil. The outcome depends on the choices we make and actions we take in the near future.



Here is a plot of the growth in human population over the last 2000 years or so. It is currently just over 6 billion people, and it is expected to peak just over 9 billion around 2050, and then decline afterwards.

Out of curiosity I plotted where my expected life span falls on this curve. Everyone reading this has their lifespan fall into a roughly similar range.

The result is rather startling when you look at the graph. It's a very clear visible indication that we are living in what is probably the most important generation in the history of the human race.

People mistakenly think of the future as a straight forward extrapolation of the past

1. Explosive Growth in technology
2. Living on a finite planet

Instead, get used to three curves:

1. Exponential growth - technology
2. The bell curve – non-renewable resources
3. Overshoot and collapse – renewable resources

People mistakenly think of the future as a straight forward extrapolation of the past.

But there are two important reasons why such extrapolations are innacurate:

- 1) Explosive Growth in technology
- 2) Living on a finite planet

Instead, we need to get used to the three types of curves above, which I'll describe later.

First:

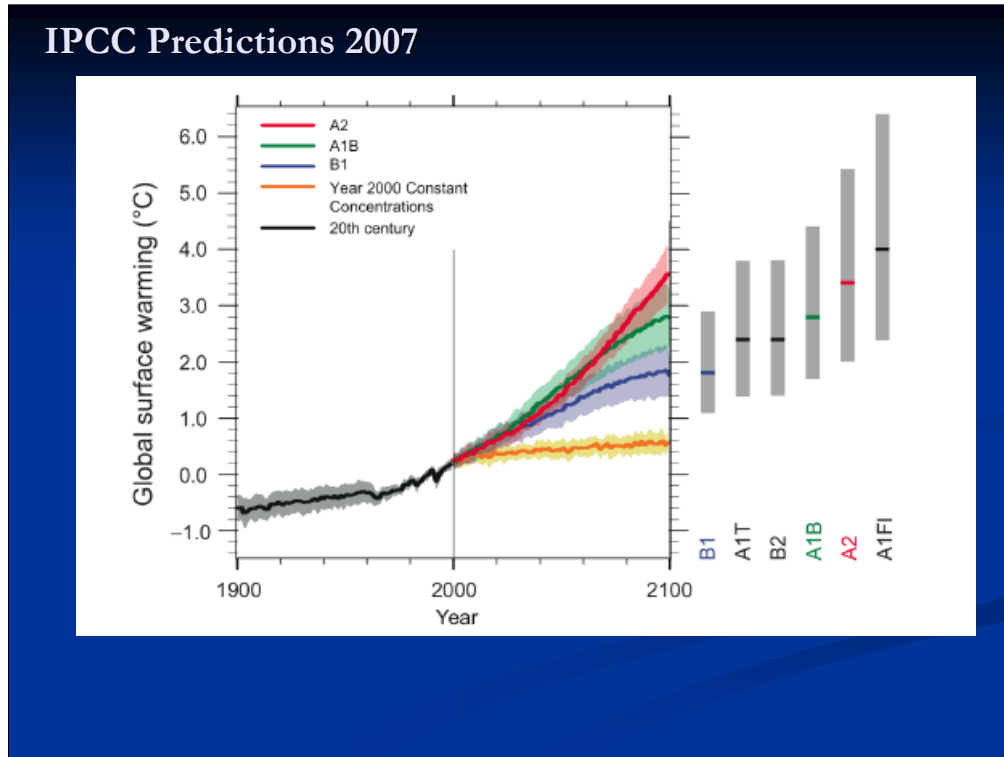
***The Perfect Storm of  
Problems***

## A Perfect Storm of Problems is Approaching

- Climate Change
- Peak Oil
- Resource Depletion
- Economic Meltdown and the end of the American empire

We will cover these four areas.

There are other problems we can't get to because of time, including the population bubble and WMD proliferation. Rest assured, these are important parts of this collection of major problems that we will have to deal with.




Here are the latest projections from the International Panel on Climate Change, which is the most authoritative scientific report we have on climate change. The different curves represent the results of different growth scenarios.

Just to give you a perspective on things, the difference between the global temp today and the average of the last ice age, when there was over a thousand feet of ice over our heads on this spot... was about 6C.

Which country is now the number one producer of CO<sub>2</sub>? China passed us last year to claim the number one spot.

China's CO<sub>2</sub> output is doubling every decade, causing the world's CO<sub>2</sub> to grow much faster than even the worst case scenarios. The large number of coal fired power plants that they are building now will be in operation for the next 40-80 years. But don't place all the blame on China, remember that much of what they're producing is for export to the United States.



By far the most terrifying film you will ever see.

**an inconvenient truth**  
A GLOBAL WARNING

An Inconvenient Truth on DVD  
November 21

**“Climate change** somehow seems unable to emerge on the world stage for what it really is: the single biggest challenge facing the planet, the equal in every way to the nuclear threat that transfixed us during the past half-century”

- Bill McKibben

I won't go into a lot of technical detail in the interest of time, but let me summarize some thoughts.

Climate change will continue to happen - It's unlikely that we will do more than slow it.

But there is a potential for catastrophic and essentially permanent changes if we do nothing. This includes

- Major growth in deserts,
- Destruction of rainforests
- Destruction of ocean habitats
- Feedback inducing run-away climate effects

The timing of reaching such tipping points is unknown, but...

We should assume we have about a decade left to prevent them.

10 more years of inaction – Greenland melts producing a 20ft rise in sea level\*

20 more years of inaction – West Antarctica melts producing another 20ft rise in sea levels.\*

•Predictions from: Joseph Romm, Executive Director, Center for Energy and Climate Solutions

To further quote from Bill McKibben: “That lack of preparation and precaution dwarfs even the failure to prepare for the September 11 attacks, and its effects will be with us far longer.”

## Peak Oil Theory



The rate of extraction of any non-renewable resource tends to follow a bell-shaped curve over the long term

- This applies to any individual oil field, or for the oil production on the planet as a whole

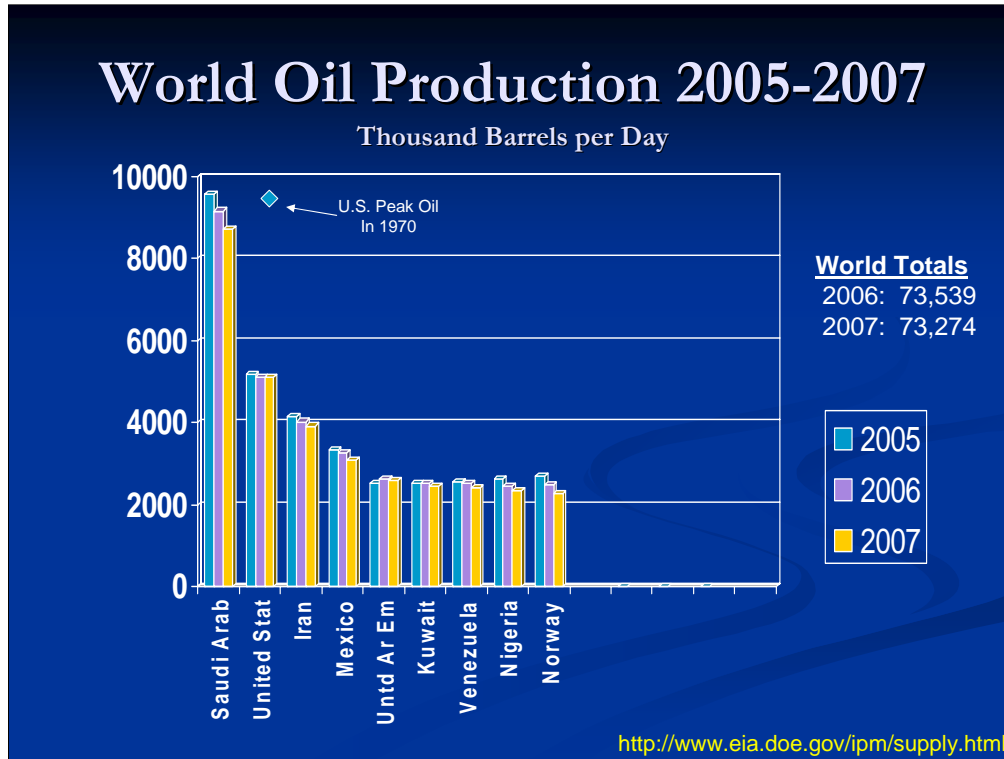
Let's move on to a discussion of peak oil, which has been getting a little less publicity than climate change over the past few years but which will probably get a much bigger focus shortly.

In 1956, American geophysicist Marion Hubbert predicted that production of oil would peak in the continental United States around 1965-1971. This was at a time when American oil production was rising rapidly with no end in sight. He was widely ridiculed for this prediction.

The actual peak was in 1970

Hubbert further predicted (in 1956) a worldwide peak at "about half a century" from publication.

So what does the actual data show?

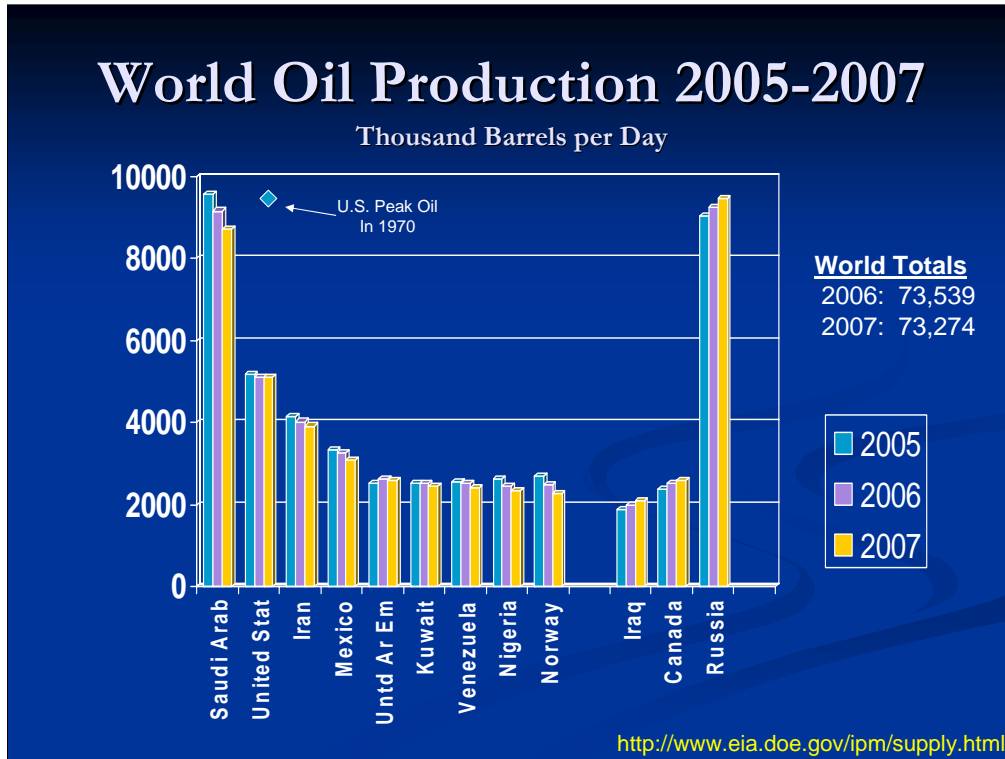


Here's the data for the last three years from the department of energy. The data indicates that we are essentially at the peak and that it may have actually occurred in 2006.

From this point on, supply will continue to decline while demand continues to grow, resulting in steady price increases for as long as we can see.

And it also means that any group of people that gets to increase their consumption of oil means some other group gets less oil.

By the way, if you consider the prospect for actually sharing the world's oil resources, in terms of oil production per capita, we hit the peak in 1979 and have been falling ever since.

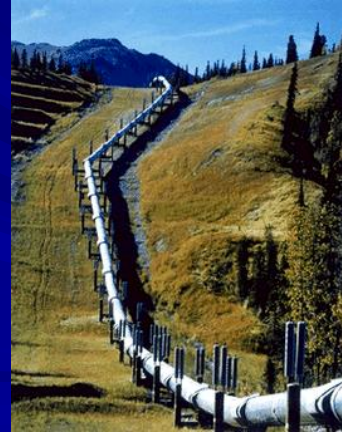


Here are the three countries that had a noticeable increase in their oil production over the past three years.

There is also concern now that Russia's oil production is starting to fall. The production for the first 3 months of 2008 is 1% less than the first three months of 2007

A new Goldman Sachs prediction that oil prices could rise to \$150 to \$200 within two years.

## Prudhoe Bay and the Trans-Alaskan Pipeline

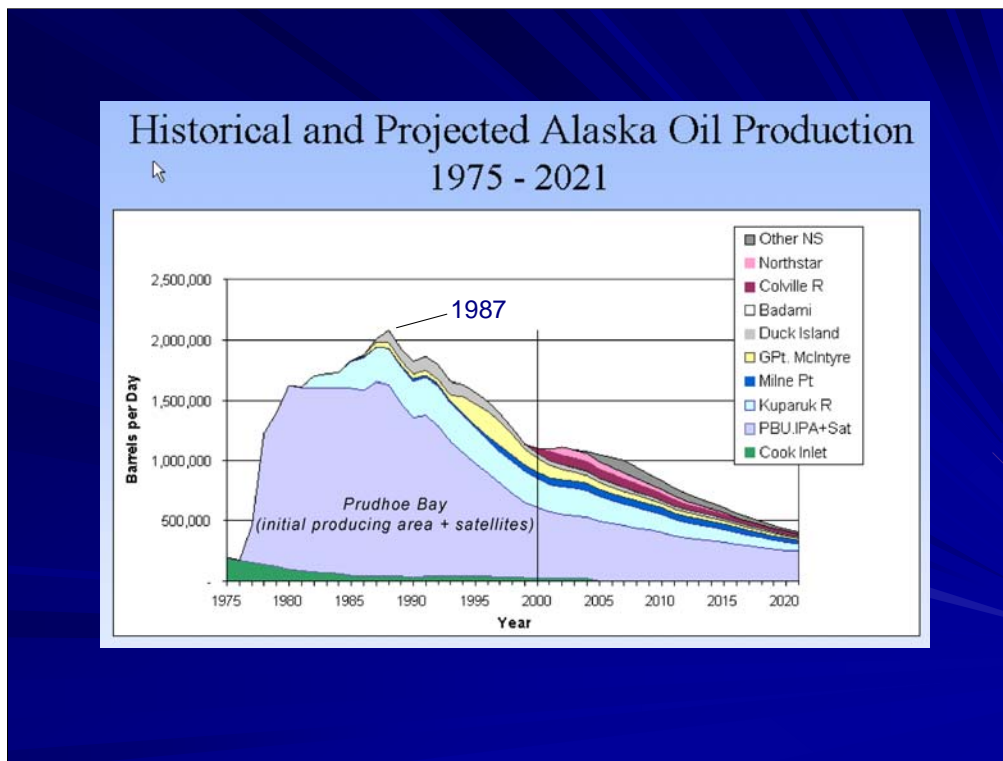


Getting oil from Alaska is an important issue that will probably be in the news a lot in the future, so let's talk a little about that.

Oil production at Prudhoe Bay on the north slope of Alaska started in the 1970s. Oil was pumped down through the Alaskan Pipeline to the port of Valdez on the southern coast of Alaska, where it is carried by ship to the west coast of the United States.

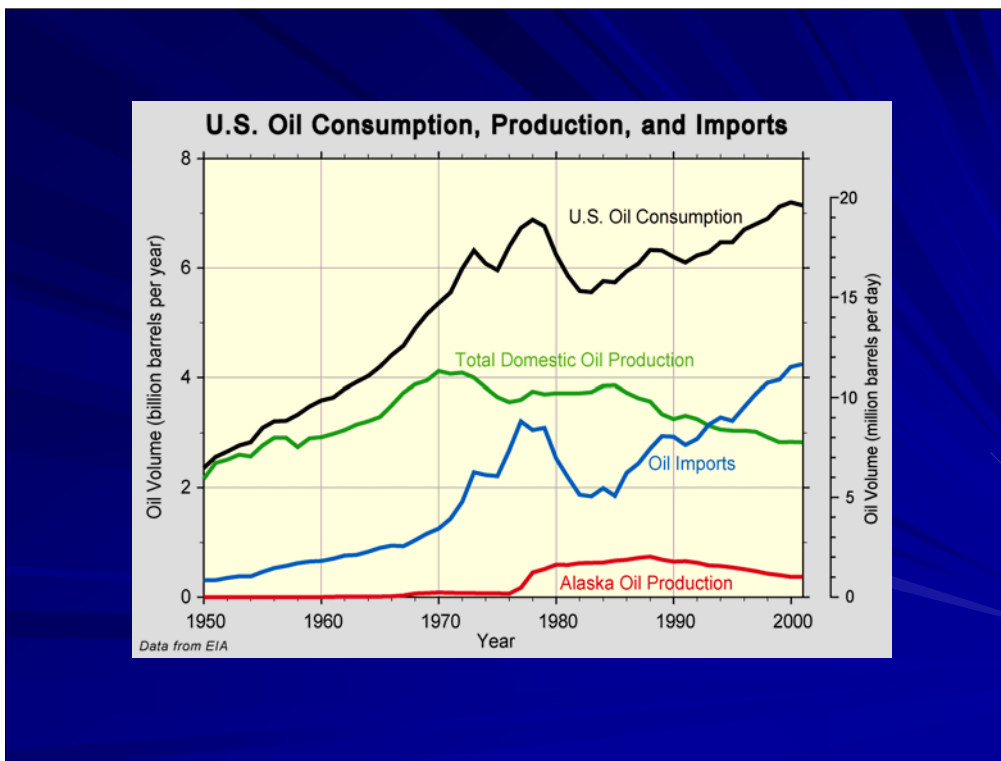
The field is operated by [British Petroleum](#); partners are [ExxonMobil](#) and [ConocoPhillips](#)

Prudhoe Bay, like any other oil field, should experience a peak in its production. Any guess on the date of such a peak?



Answer: 1987

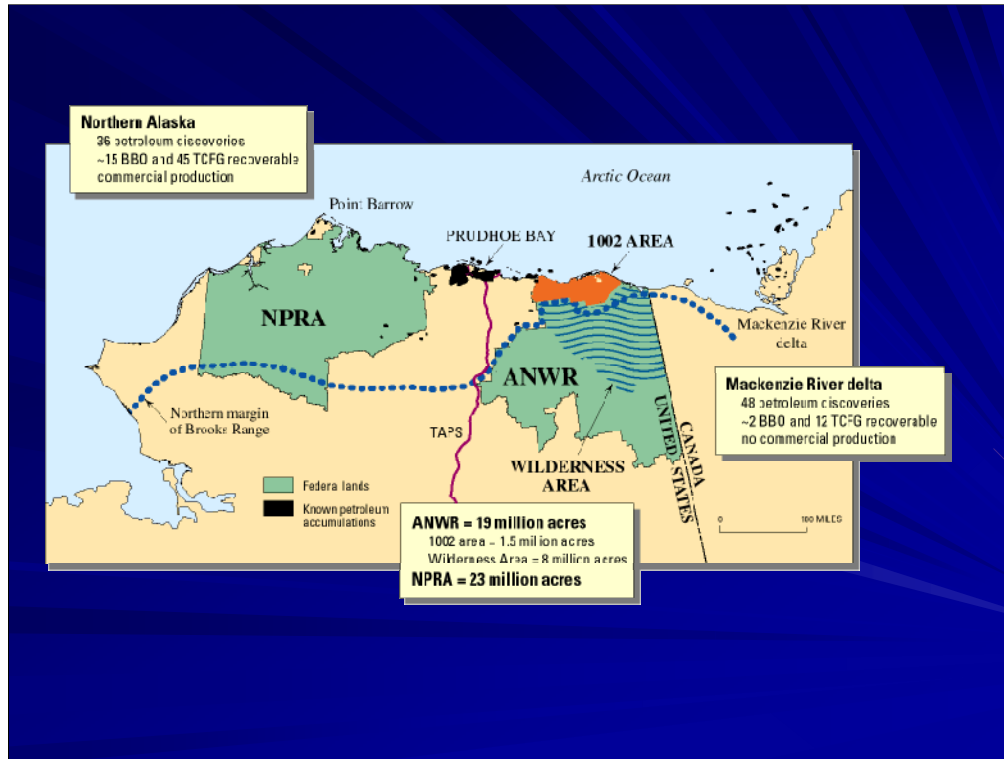
There was an estimated 13 billion barrels of recoverable oil at Prudhoe Bay, of which 10 billion have already been pumped out.



Here is a chart of the overall rate of US consumption of oil and the sources that oil comes from. Note what a small portion the Alaskan oil makes up.



This picture from the north coast of Alaska is not Prudhoe Bay. Any guesses where it is from? The Arctic National Wildlife Refuge (ANWR). A big controversy has been in the news since the Carter administration about drilling for oil here too.



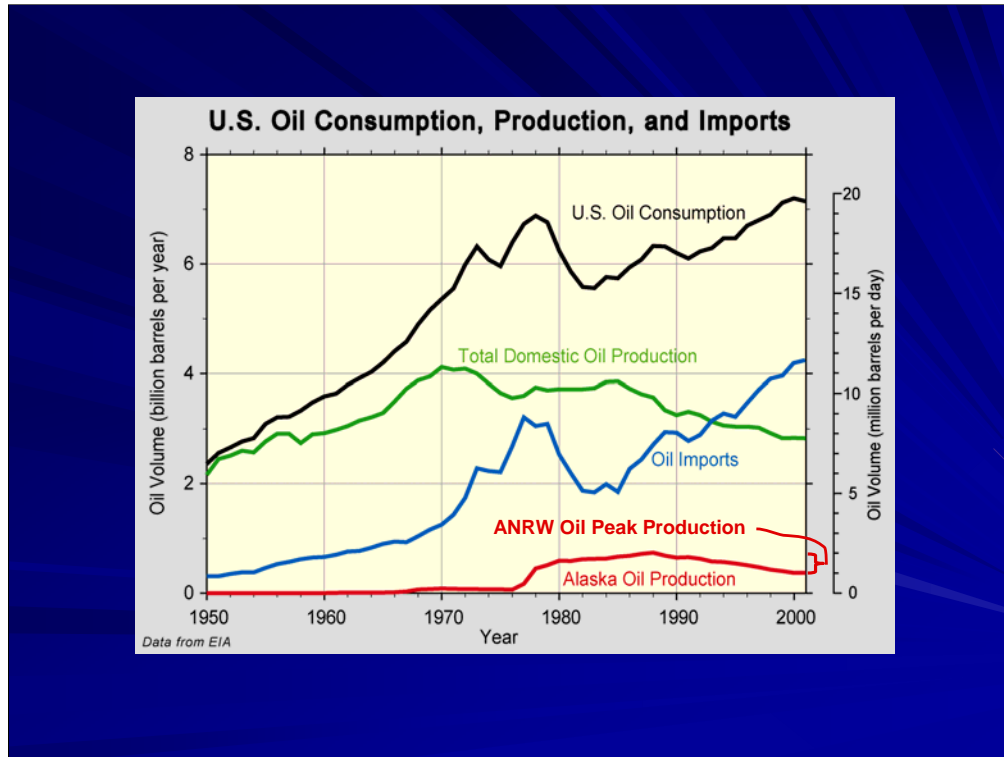
Here is a map of the north coast of Alaska. The Arctic National Wildlife Refuge is the green area on the right. The orange area along the coast is the area where drilling for oil has been proposed and is in dispute.

ANWR: recoverable oil = 6 Billion to 10 Billion barrels (less than the 13 Billion at Prudhoe Bay).

The peak rate of oil extraction is expected to be about 1 million barrels per day, but this wouldn't happen until about 2025 if the drilling permits were issued today. Unlike Prudhoe Bay where the oil is in a few large pockets, the oil in ANWR seems to be distributed in a larger number of scattered small pockets, making it harder to extract.

By the way, the NPRA is the National Petroleum Reserve in Alaska, and is considered to be the largest tract of undisturbed public land in the United States. It was set aside as a petroleum reserve in 1923 but has remained largely undisturbed. There have been many drilling leases granted, but no large oil deposits have ever been found and only a minimal amount of actual oil production has taken place near the north-east part of NPRA.

<http://pubs.usgs.gov/fs/fs-0028-01/fs-0028-01.htm>

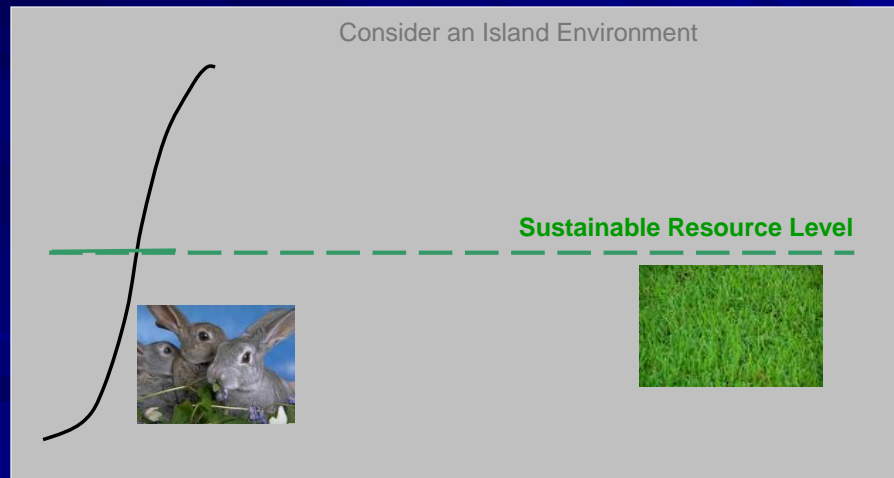


Here is an illustration of the impact that oil production from ANWR would have, but again, production at this level would not be reached until 2025 at the earliest.

Although this is a fairly negligible portion of our oil consumption, it will probably be done at some point. When oil prices rise above \$200 / barrel the economic profit will be too tempting, and as gas prices exceed \$5 / gallon the public pressure to do *something* will be too great to ignore.

When you hear certain radio talk show hosts talk about how we could achieve oil independence if the “environmental wacos” would just let us drill in ANWAR, the above chart should give you an alternative view of real situaion from the *reality based world*.

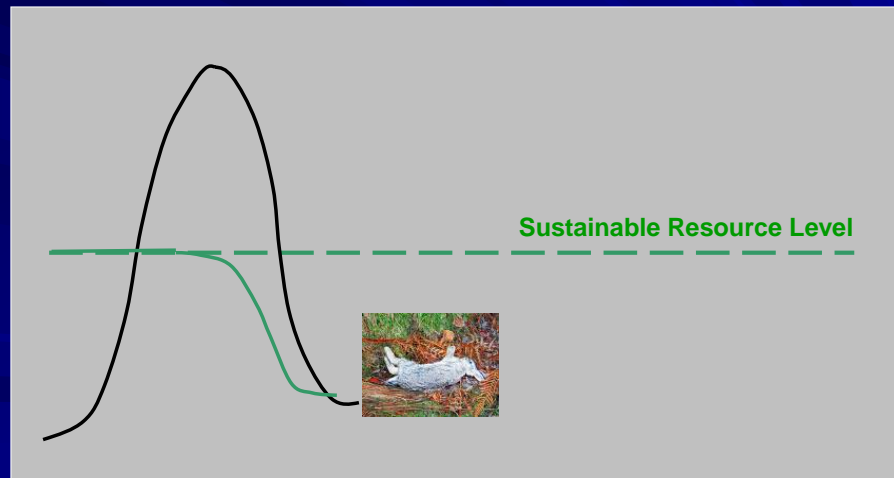
## Overshoot and Collapse Renewable Resource Usage



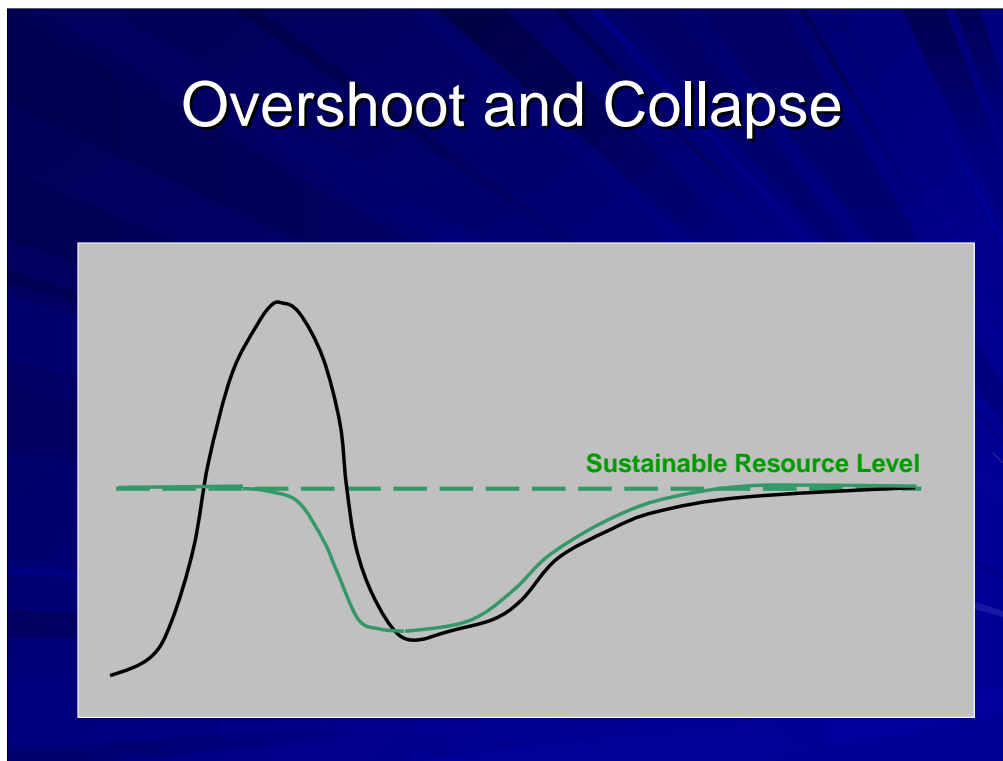
Now let's talk about the phenomena of overshoot and collapse when dealing with finite but renewable resources. Many of you may be familiar with this from biology courses, since it's a very common phenomena in ecological systems. But let's quickly review.

Consider an island with a healthy crop of grass, clover, and other ground vegetation. Suppose some rabbits are introduced to this island for the first time. They will do what rabbits do, eat the vegetation and start reproducing. There is some sustainable population level where the rabbits eat the vegetation at about the same rate that it grows back, but if the rabbits reproduce too quickly they can overshoot this sustainable population.

## Overshoot and Collapse



When this happens the majority of the vegetation will be eaten, causing the rabbit population to crash as they die of starvation.

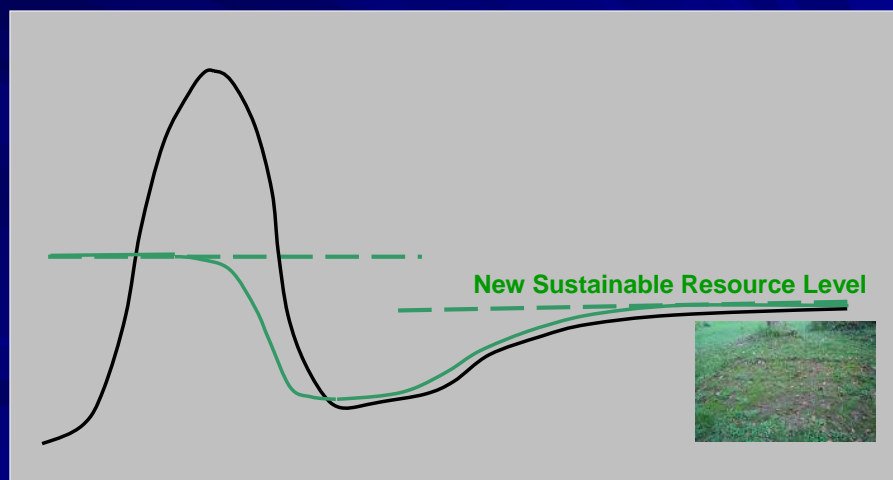


After some time, the vegetation and rabbit populations will gradually return to some sustainable levels, hopefully without a population overshoot this time.

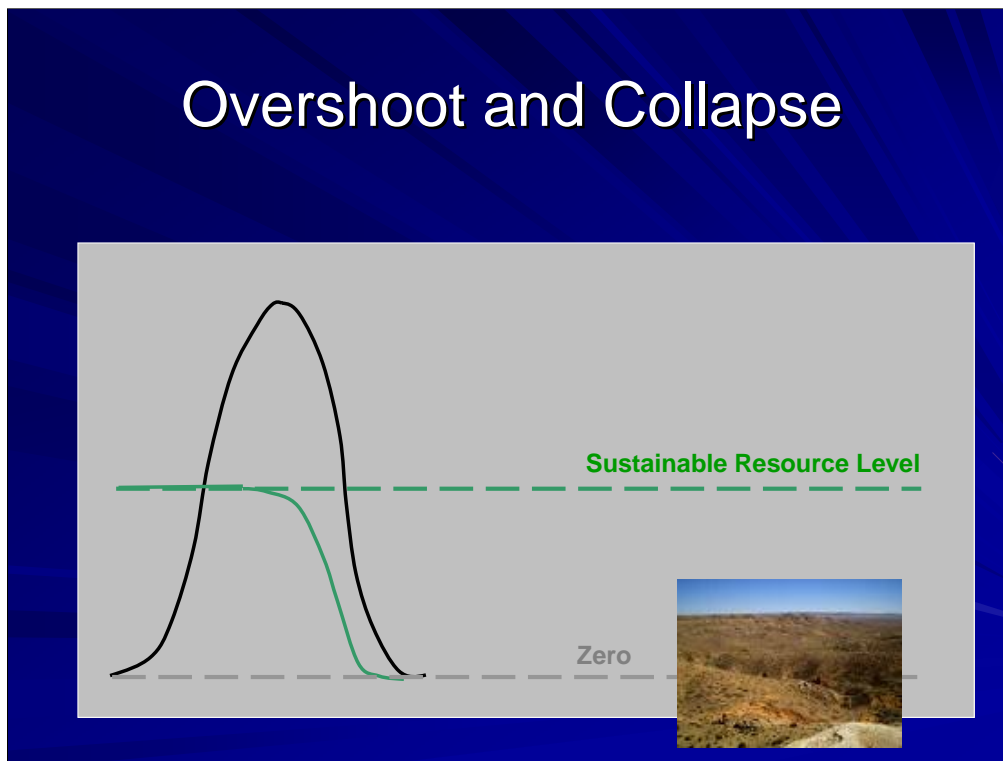
Thus you can have a “peak phenomena” somewhat similar to the use of non-renewable resources, but in this case the usage eventually returns to a sustainable level.

The size of the population collapse and the amount of time it takes to recover depends on just how bad the overshoot is. The bigger the overshoot beyond the sustainable level, the more dramatic the crash is when it finally comes.

## Overshoot and Collapse



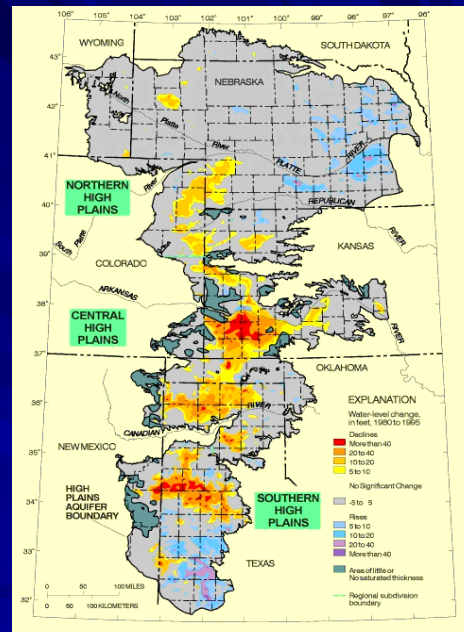
If the overshoot is bad enough, it can permanently damage the ecosystem to the point where the new sustainable level is reduced from what it previously was.



And in the worst case, the most serious collapse can result in the population going extinct and the ecosystem permanently destroyed.

## Peak Water ?

- We are using much more than is being replenished
- Water tables are falling drastically around the world
  - 3-10 ft per year in India
  - The great Yellow River in China runs dry before reaching the sea most days
- 100s of millions of Africans will face water shortages in under 20 years



Water Table Falling in the US Farm Belt

Fresh water is a renewable resource. Can our usage reach a peak and then decline in an “overshoot and collapse” phenomena? Certainly, and that’s what appears to be happening around the world.

## Peak Rice / Peak Wheat?

- Arable land is declining
  - Development and soil erosion....
- Water usage is already past its sustainable limit and will decline
- Oil available for fertilizer production has peaked
- This is a long term problem



It's important to note that the green revolution of the last few decades significantly increased crop yield by relying on substantially increased use of land, water and fertilizer.

But six long years of drought have taken a toll, reducing Australia's rice crop by 98 percent

Due to climate change, food production in tropical areas of Latin America is predicted to decline by at least 20% over the next 70 years, across Africa by 30% downturn, and in India as much as 40%.

# Food

“The Silent Tsunami” – *The Economist* April 19th

- The problem is price more than a lack of food.
  - Increase fuel costs -> increased fertilizer costs
  - Growing middle class in India and China
  - Growing increase in meat consumption
  - Hoarding, export restrictions
  - Use for Biofuels
- Reducing supply
  - Climate change and drought (esp. Australia)
  - Water shortages
  - Arable land being taken out of service
  - Increase farming costs and difficulty getting loans

**Shooting up**

Grain prices, \$ terms, January 2nd 2007=100

Sources: Chicago Board of Trade; Jacksons

2008 will definitely be a legendary year in the grain history book

But the food scare of 2008, severe as it is, is only a symptom of a broader problem. The surge in food prices has ended 30 years in which food was cheap,

In El Salvador the poor are eating only half as much food as they were a year ago. Afghans are now spending half their income on food, up from a tenth in 2006.

The main reason why Kenyan and Ethiopian farmers planted less this year was not just that fertilizers were expensive, but that farmers could not get credit to finance purchases.

Scientists expect the problem to worsen. Even a slight warming would lower agricultural output in the tropics and subtropics.

<http://www.nytimes.com/2008/04/17/business/worldbusiness/17warm.html>

The middling poor, those on \$2 a day, are pulling children from school and cutting back on vegetables so they can still afford rice. Those on \$1 a day are cutting back on meat, vegetables and one or two meals, so they can afford one bowl. The desperate—those on 50 cents a day—face disaster.

### **Food Instability - If you're hungry, you get angry quicker”**

The world is only one poor harvest away from total chaos in world grain markets.

## U.S. Military Empire Overshoot

The total of America's military bases in other people's countries in 2005 was...

.... 737

The proposed FY 2008 Military Budget

- \$449 Billion Base FY 2008 military budget
- \$647 Billion Including Afghanistan and Iraq occupations
  
- Greater than all other military budgets in the world combined

FY 2008 military budget is:

30x higher than all spending on State Department operations and non-military foreign aid combined.

120x higher than the U.S. government spends on combating global warming.

The American military empire is WAY, WAY overextended and highly resistant to change. This is ripe for a significant collapse. None of the presidential candidates are talking about this.

# Unsustainable Economics

It is in the economic sphere that the US empire  
will probably first begin to unravel

- **Federal Debt**
  - \$500+ billion Federal budget deficit,
  - Total national debt of over \$7 trillion (and growing)
- **Foreign Trade Imbalance**
  - \$630 billion trade deficit with the rest of the world
- **Retirement Costs**
  - Major funding problems as baby-boomers reach retirement age
- **Health care**
  - Maybe 5 years left of current system for it falls apart
- **Housing bubble bursting and families overextended with debt**
- **Peak Oil**

All these problems will become worse if (or when) the major oil exporting nations decide to switch from the current dollar standard to the Euro for pricing oil

## Definition of “Being Bankrupt”

**An entity is so far in debt that there is no foreseeable way of ever paying off those debts.**

- **There is no foreseeable way to pay off our national debt.**
  - We are borrowing an additional \$1.5 Billion per day just to tread water.
- **The accrued liabilities of our government is \$53 trillion**
  - No funds have been set aside against this mind boggling liability.

By any reasonable accounting standard, the United States would qualify as being bankrupt

Pause... Relax... Breathe



Questions ?

Topic Two:

***A rate of technological  
change far greater than  
what most people realize***

1900



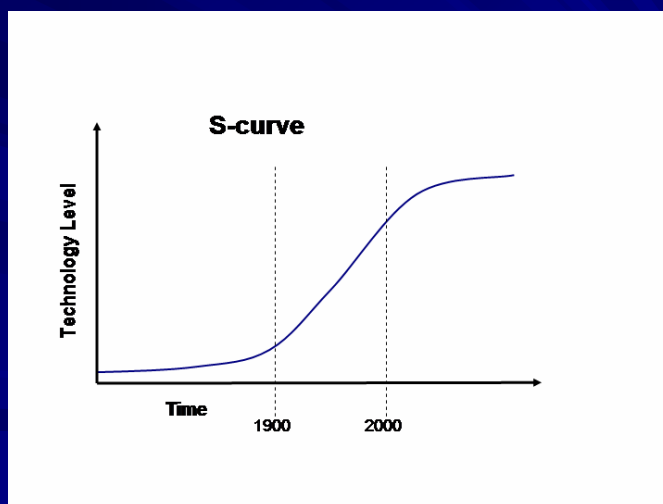
No:  
Powered flight  
Theory of atoms  
Knowledge of DNA or antibiotics

Here is the state of art technology at the beginning of the last century.



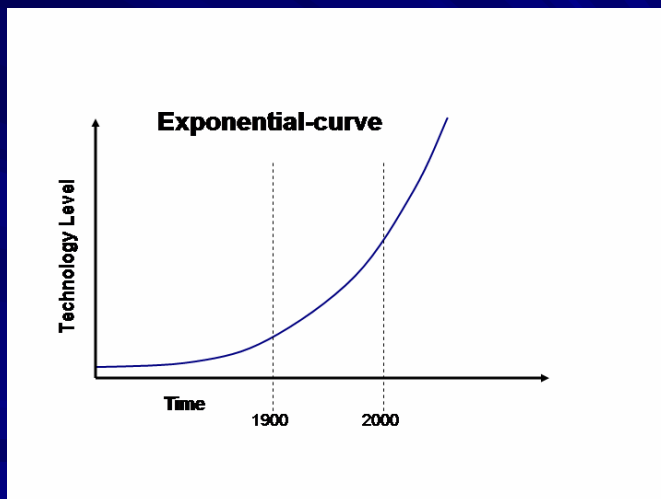
And here it is at the end of the last century. This is without a doubt the most radical change in humans society in any century by far.

## What will Happen to that Rate of Change this Century?



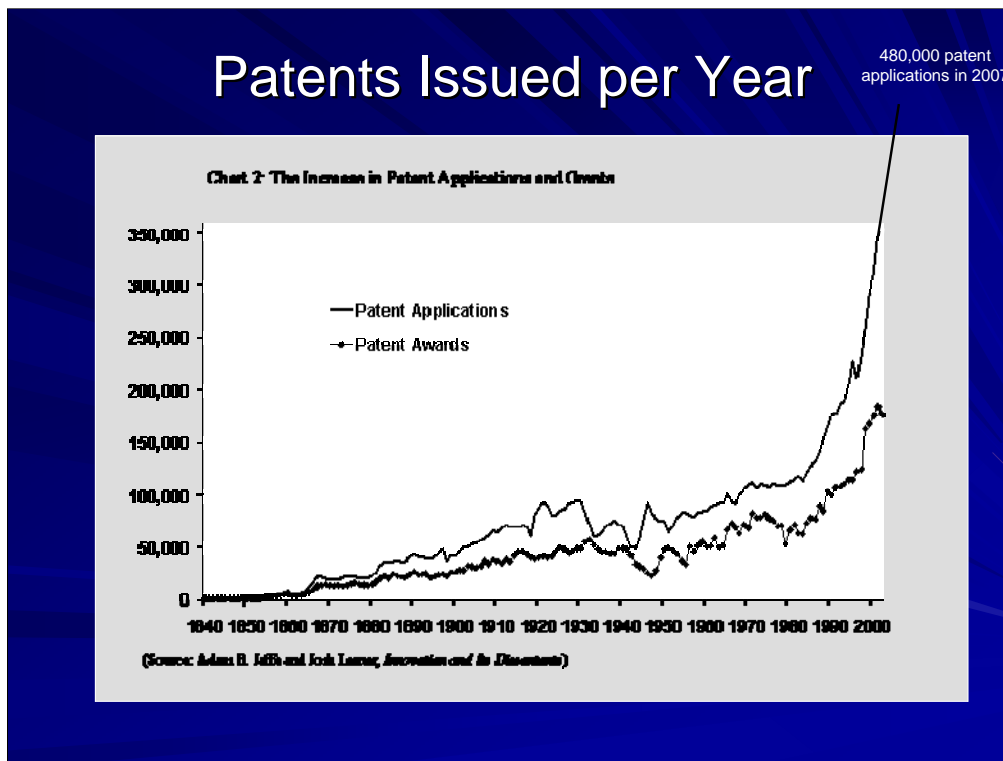
So what is likely to happen this current century? One view is that the rate of technological change will slow since we already made the easy discoveries and new developments get harder.

## Or Will it Be ?



The other view is that technology will continue to feed on itself producing continued exponential growth at an accelerated rate.

Which view is true? Is there any evidence to help us decide?



Patent applications in 2007 = 480,000

99% of all scientists who ever lived are alive today.

## Examples of Big Changes since just 2000

- In 2000 the price of gas was... **\$1.50 / gal**
- Google's stock is now at ~\$550. In 2000 it was.... **Nonexistent**
- Wikipedia contains 10 million articles. In 2000 it had..... **Zero**
- Facebook has 69 million active users. In 2000 it had... **Zero**
- Myspace has 100 million accounts. In 2000 it had.... **Zero**
- YouTube has 83 million videos, 3 billion views per month... **Zero**
- The average American vehicle gets 21 MPG. In 2000 it was **22 MPG**

Average MPG in Europe is 36. US figures are brought down by the popularity of SUVs and pickup trucks

## Comments from Ray Kurzweil

### A transforming event is looming in the first half of the 21st century

- People tend to think in terms of linear rates of change, but technology is exponential.
  - people overestimate what can be achieved in the short term
  - people underestimate what can be achieved in the long term
- We will see what seems to us as “100 years of progress” occur in 25 years.

In this century we will experience a growth of technological about 1000x what we experienced in the 20th century.

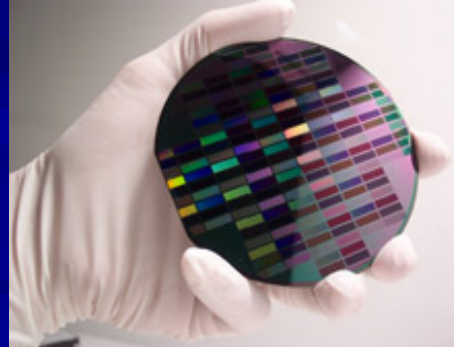
## Biotechnology

- New breakthroughs announced on an almost weekly basis.
- Major source of venture capitalist investment
- Profound increase in understanding biological functions
- Profound increase in understanding brain functions

We will look at some selected aspects of this since time does not permit a comprehensive overview.

## DNA Sequencing of Humans

- 1990s - \$3 billion and a decade to produce a rough draft.
- 2000s - \$1 million ~3 years
- Last Year - \$350,000
- This Year - \$60,000
- 4-6 years from now \$1000
- 6-10 years from now \$100
- It will eventually become a standard test done at birth



Some scientists are concerned that our ability to generate this information is now outstripping our ability to use it.

## Managing you Body Chemistry

Performance enhancing drugs  
will become

- Much more common,
- Easier to produce
- Harder to detect
- Socially acceptable
- Highly profitable

■ We are in the last decades of  
professional sports as we  
know them.



Scientists at the University of Pennsylvania who created genetically modified “mighty mice” have been deluged by calls from athletes and coaches who want to try this technology themselves. These mice are shockingly large and muscular. They are built like steers, with massive haunches and necks wider than their heads.

Could such gene doping work in humans—assuming it isn’t already? “Oh yeah, it’s easy,” H. Lee Sweeney, chairman of Penn’s Department of Physiology, told *The New York Times*. “Anyone who can clone a gene and work with cells could do it. It’s not a mystery....You could change the endurance of the muscle or modulate the speed—all the performance characteristics. All the biology is there. If someone said, ‘Here’s \$10 million—I want you to do everything you can think of in terms of sports,’ you could get pretty imaginative.”

2006 winter Olympics may be the last games without any genetically modified athletes. Genetic modification is impossible to detect at this time, and it will be very difficult to develop a viable test in the future.

## Managing you Brain Chemistry

- There is a growing use of drugs to enhance mental performance
  
- A new generation of more power mind effecting drugs is on the way.
  - For performance enhancements and recreation
  
- How profound will this be to society?
  - Potentially VERY.

The use of drugs to enhance mental performance is becoming more common than most people realize

College students take Ritalin to help improve their concentration and test scores

20 percent of scientists admitted to using brain-enhancing drugs

Musicians are taking propranolol to reduce performance jitters.

These drugs represent only the first primitive generation of cognitive enhancers. Around the country, companies such as Memory Pharmaceuticals, Sention, Helicon Therapeutics, Saegis Pharmaceuticals and Cortex Pharmaceuticals are racing to bring memory-enhancing drugs to market before the end of this decade. If clinical trials continue successfully, these pills could be a bigger pharmaceutical bonanza than Viagra. Not only do they hold the promise of banishing the senior moments of aging baby boomers; they might improve the SAT scores of kids by 200 points or more.

Almost 90% of business majors reported at least occasional use of "smart pills" at crunch times such as final exams, including Adderall, Ritalin, Strattera and others. "We're going to see it not only in schools, but in businesses"

<http://www.washingtonpost.com/wp-dyn/content/article/2006/06/10/AR2006061001181.html>

Suppose the human components of societies and institutions can also be made better, even by a little bit?

## Reproduction



- Human cloning will become practical soon - deal with it.
- Genetic modifications to humans will start becoming practical soon after
- The controversy over stem cell research is just a minor warm-up compared to what is coming in the next few decades.

## Synthetic DNA on the Brink of Yielding New Life Forms

First DNA synthetically created from scratch in 2007.

First living organisms containing synthetically created genes expected this year.

Potential to design organisms that will create cheap medicines, ethanol, or algae-based biodiesel



Scientists at LS9 Inc. in San Carlos, Calif., are using artificial DNA to reprogram *E. coli* bacteria to produce a cheap alternative fuel. (Photos Courtesy Ls9)

Scientists have already built the world's first entirely handcrafted strand of DNA made from scratch in a laboratory. This year (2008) they hope to transplant it into a cell and get it to start functioning. The goal is to eventually make living cells containing artificial chromosomes that produce valuable chemicals, medicines, ethanol, hydrogen and other exotic fuels for vehicles.

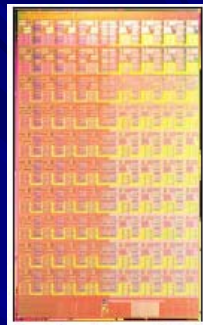
At the core of synthetic biology's new ascendance are high-speed DNA synthesizers that can produce very long strands of genetic material from basic chemical building blocks

This also raises a big safety concern about accidentally or deliberately creating new deadly diseases effecting plants or animals, including humans. There needs to be a new well thought out plan on how to control and regulate this, but it will be very difficult to create and put in place.

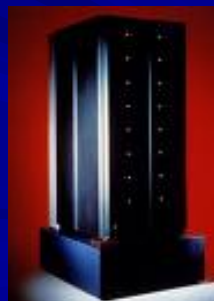
## Computers

May be the most profound of the changes.

- Moore's Law Growth doubles capabilities every 1-2 years



Deep Blue defeated Gary Kasparov in 1997.



Cell chip – literally a supercomputer from a few years ago is now being used to power video games.

## Implication of Computer Trends



Ray Kurzweil has  
Written extensively on this,  
And the concept of an  
Approaching “Singularity”

(Ray was raised a Unitarian)

# Singularity

## Technological Singularity

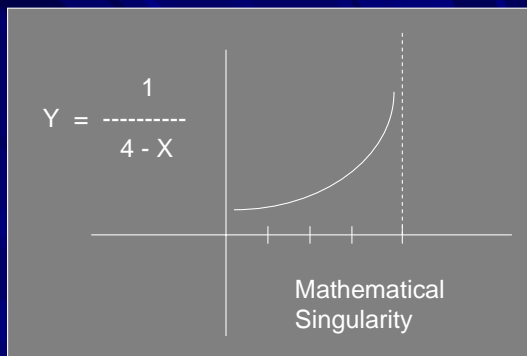
Similar to a mathematical singularity in spirit in terms of very rapid change, but nothing “goes to infinity”.

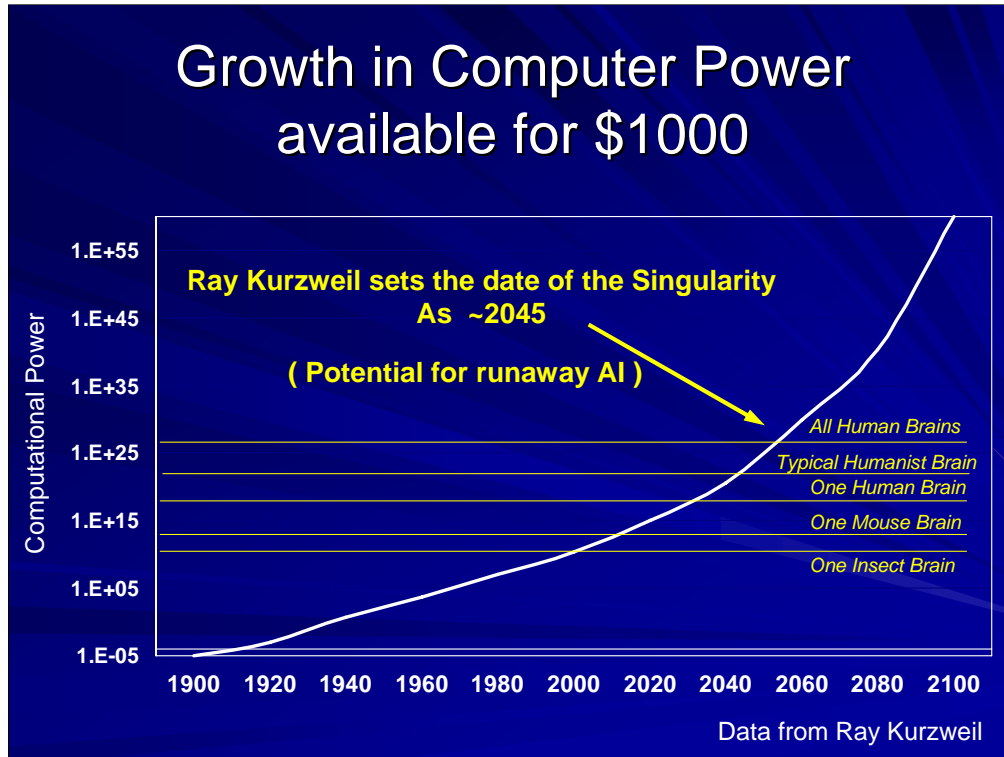
It is a period during which the pace of technological change will be

- so rapid,
- its impact so deep,

that human life will be irreversibly transformed.

**The change is so profound that accurate predictions of what technology and society are like after the singularity are essentially impossible to make.**





Artificial intelligence is already so sophisticated that you sometimes can't immediately tell if you're talking on the phone with a human or a machine. Russian automated chatbots are good enough to pass simple Turing tests (and immediately being used for sex chat.)

There may be no sudden turning point in the development of AI, just a long series of computers doing more and more things that once only people did, especially for avoiding disaster in emergency or complex situations. Defense and security are big motivators, especially when it comes to filtering data and pattern recognition, etc...

Interestingly, 2045 is 100 years after the first nuclear explosions, which suggests that the century from 1945-2045 is really the key important time period for the human race. We are ~2/3 of the way through it, and rapidly picking up steam in the climactic final third.

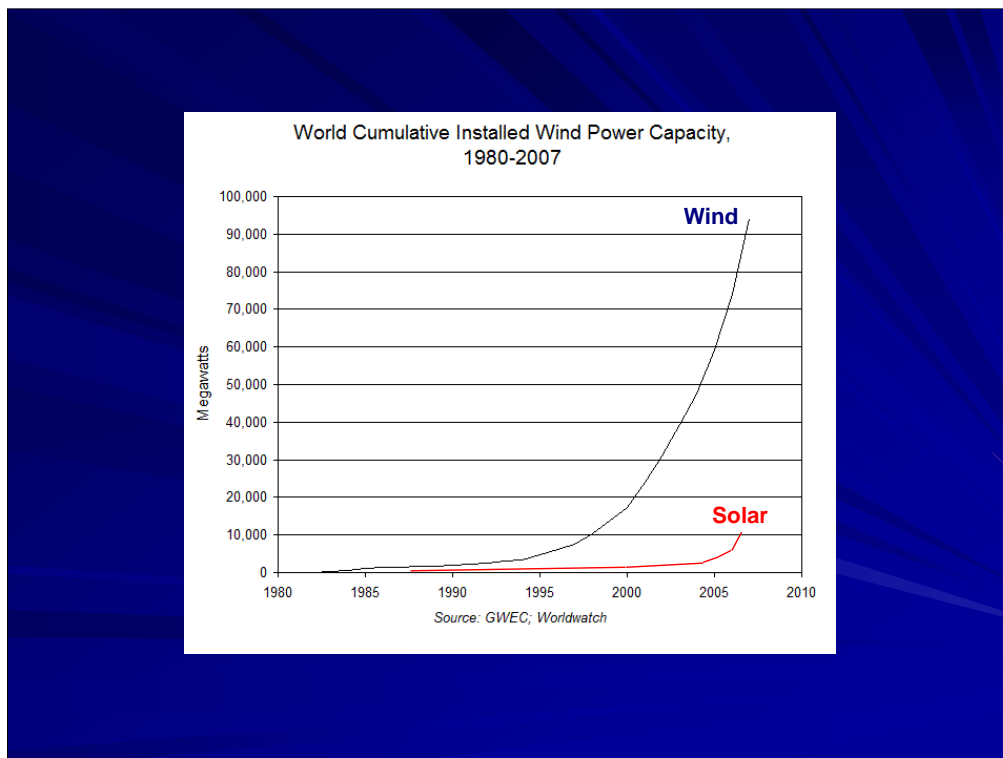
Pause... Relax... Breathe



Questions ?

Topic Three:

***Optimism About Major  
New Positive Trends  
and Opportunities***



<http://www.earth-policy.org/>

Currently wind produces just over 1% of world's electricity

Growth in wind power capacity is 25% per year doubling every 3 years

Growth in photovoltaic capacity is 41% per year doubling every 2 years

## Advances in Photovoltaic Cells

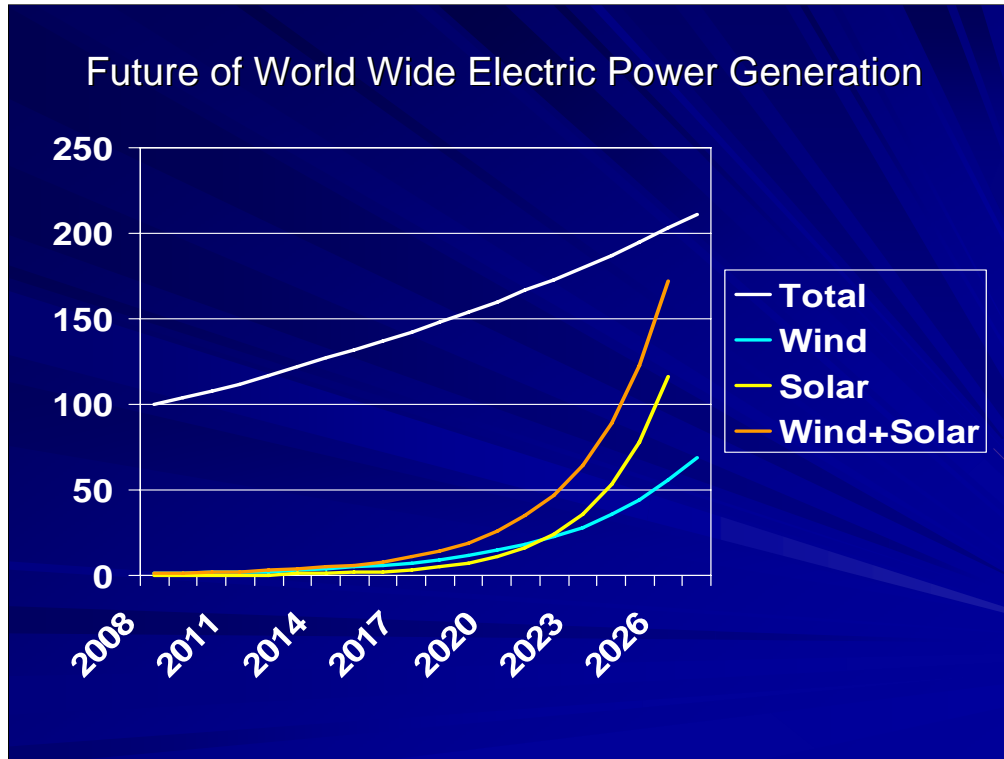


Solar energy is already more cost effective than fossil fuels in Hawaii. It will become more cost effective in California and Japan in 2012-15, and in overcast England by 2020.

Sunrgi (California) promising solar at 5 cents per KW hour. uses a special lens to magnify sunlight and produce a very bright, powerful, focused spot of light.

Scientists at the University of Tel Aviv in Israel claim they have found a way to construct efficient photovoltaic cells costing at least a hundred times less than conventional silicon based devices, and with similar or better energy conversion efficiency. The reactive element in the device is genetically engineered proteins using photosynthesis for production of electrical energy.... aims to develop a cost effective device of 10mm X 10mm in size within three years. (4/30/08)

The Israeli team is set to challenge others who are using photosynthesis for photovoltaic cells, including universities such as Cambridge in the U.K., and Stanford, M.I.T, the U.S. Naval Research Laboratory, and the Universities of Tennessee and Arizona in the U.S, and several others



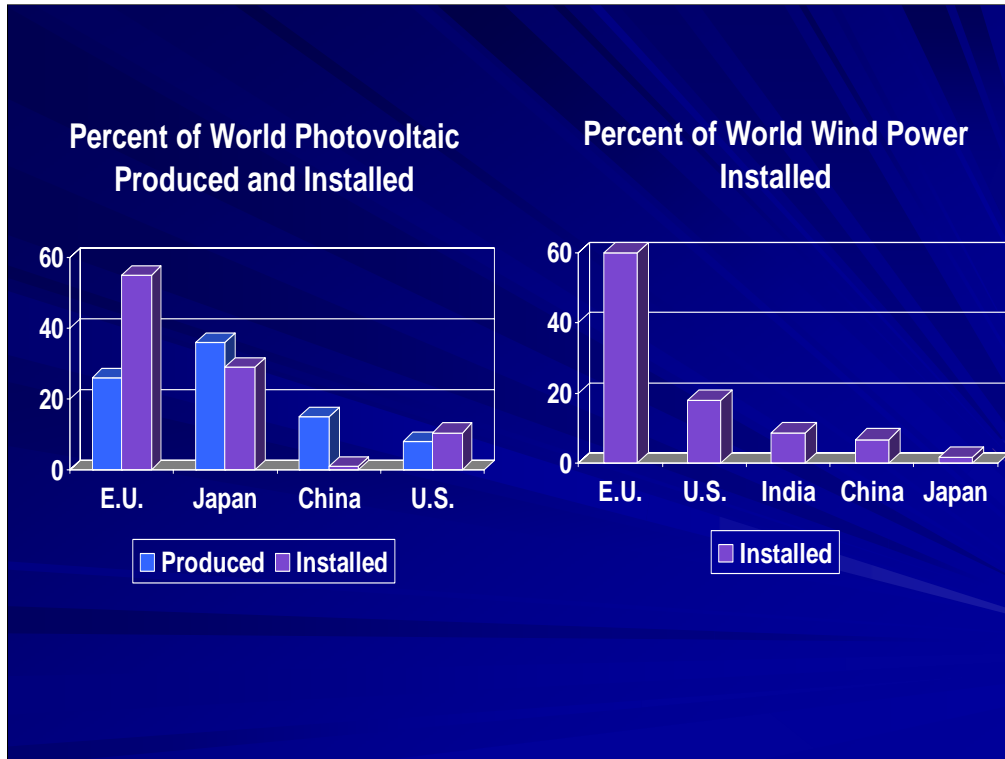
World growth in electricity generation is 4% per year

Growth in wind power capacity is 25% per year

Growth in photovoltaic capacity is 41% per year

This will only happen if we stop building new coal power plants soon and start gradually decommissioning those we have

Nuclear power plants historically take 10-12 years to start producing power from the time the license is first applied for. That would mean the first new ones could go online around 2020. They would then build out the nuclear power industry by adding a few more plants each year for the next 10-20 years.



All the E.U. (European Union) activities in these areas is dominated by Germany.

E.U. is currently the dominant producer of wind power turbines. China is expanding production tremendously and may take over first place in 2010. At the moment, the demand is outstripping supply for wind turbines, keeping the prices from falling as fast as they did in the past.

Photovoltaic data: [http://en.wikipedia.org/wiki/Photovoltaics#Economics\\_of\\_PV](http://en.wikipedia.org/wiki/Photovoltaics#Economics_of_PV) (end of 2006)

Wind Power data: [http://en.wikipedia.org/wiki/Wind\\_power](http://en.wikipedia.org/wiki/Wind_power) (end of 2007)

## Causes for Optimism

- Nations renouncing their Nuclear or WMD programs.
  - Libya – WMD program
  - South Africa – nuclear weapons
  - Ukraine, Belaruse, Kazakhstan – nuclear weapons
- We successfully avoided destroying the ozone layer by international cooperation.
- Good examples of sustainability abound.
- We are actually in an amazingly peaceful period
- The 2008 Election

When the Soviet Union fell apart, Ukraine suddenly found itself to be the 3<sup>rd</sup> largest nuclear power in the world, having more nuclear weapons than England, France, and China combined.

Good examples of sustainability and social change from Norway and Sweden, state governments, and the business community

**Google** is installing a fairly large 1.6 Mega Watt (MW) solar power generation plant on the roof of their headquarters. **Walmart** is seeking proposals for a much larger 100 MW system

We are living in the most peaceful period in 40-50 years (university of Maryland study)

Harvard professor Steven Pinker has ventured to speculate that we are probably living “in the most peaceful time of our species’ existence.”

2008 already is a pivotal election because of the candidates we have, and the ones that failed, and because of the tone, and the number of new voters that have been energized by the political process. Remains to be seen if that tone is kept, and what issues are raised. Congressional elections will also be interesting, and who knows what will state initiatives will be on the ballots. It has made young people excited about politics for the first time in a long time.

## The Age of Empire is Ending

- Empires were once rather profitable
  - But, things have now changed
- Military empires longer profitable or sustainable
  - Much greater profits can be had with less risk from international business cooperation
- We learned a lot from the Marshall plan at the end of WWII
  - Efforts to promote a new “Global Marshall Plan”

Empires were once rather profitable

Access to resources, forced labor, gold/jewels

Seldom any other way to get these through mutually agreeable cooperation

But things have now changed

Military occupation is becoming so expensive it is bankrupting societies that are pursuing it

Cooperative business agreements can benefit both sides.

Intellectual and creative efforts are more valuable than brute manual labor, require cooperation not exploitation.

Military / industrial complex are the only ones profiting, but they hold unnatural and unhealthy influence. Coke, Pepsi, McDonalds, Wal-Mart are not profiting in Iraq.

It is vitally important that we frame the lessons learned from Iraq in this way

Steps to prevent nuclear proliferation or a nuclear terrorist attack require international cooperative action. It won't happen with American exceptionalism, only with an effort on global elimination of nuclear weapons. William Perry and George Schultz - WSJ article

A bill to support the concept of a Global Marshall plan as the ultimate way to reduce terrorism and security threats has actually been introduced into congress as a non-binding statement.

## Signs of a growing “**Earth Community**”

- Earth Charter
- Growing international peace movement
- Growing number of trade agreements
- Growing number of international NGOs
- Treaty to save the Ozone layer
- Kyoto and the follow-on climate related processes.

## The Catalysts for Change

- Some forms of disruption can stimulate us to change
  - 9/11 Could have been one such event
  - But that opportunity was squandered
  
- Climate change could be the ideal catalytic forces that enable major social change.

Some forms of disruption can stimulate us to change

They can shake up our stagnant mindsets

They may allow us to get the deep vested interests that are blocking change out of the way.

9/11 Could have been one such event

But that opportunity was squandered

I believe that we'll have multiple other such opportunities in the next decade or two

Climate change could be the ideal catalytic forces that enable major social change.

It's grave enough to break us out of our cultural habits and overcome entrenched special interests

Yet not so insurmountable as to destroy our ability to cope

It is not the type of crisis that generate the intense anger or fear towards an external enemy

It cannot be resolved by military force

It cannot be resolved by unfettered free market economics

It cannot be resolved by traditional top-down national government

The solution requires cooperation on a global scale

But right now they're being used for social polarization

– that's got to stop

## Being Prepared

- **Is Something a Crisis or an Opportunity?**
  - The critical difference – preparation and action
  
- **There will be “Moments of Contingency”**
  - moments when small actions can have a big long term effect.
  - Actions that “set the course” for society
  
- **Whether we successfully take advantage of these will depend on:**
  - Whether or not we’re organized
  - Whether we know where we’re going and have a vision

Iraq occupation could be an important lesson if framed correctly. What did we learn from it? What is the developing narrative?

What leaders do we elect in this country?

How should we respond to a major terrorist attack if it occurs?

What research and development do we invest in?

Are the next power plants coal based or something else?

What is the best long term method to increase our security?

Articulating a new vision – Earth Community instead of military empire

## The Options

The new direction for the United States (and the world) in response to a crisis could be:

### ■ Positive

- Dominated by motivations of cooperation and responsibility
- Directed by an inspiring positive vision of the world we want
- Embracing new organizations and new technology towards those ends.

### ■ Negative

- Dominated by motivations of anger, fear, domination, and denial
- Failure to deal with the environmental problems until a the damage becomes unrepairable
- A return to authoritarianism and fundamentalism in response to traumatic chaotic change.

Which response will we take? There is no intrinsic reason to believe that one will win out over the other. It's a function of who works harder and is better prepared.



### Cynicism

It is not a "rebellious attitude"

Discourages any attempt at change

It embodies the politics of fear

it is the outlook that is most likely to lead an attitude of surrender and submission

### Optimism

It can be a revolutionary attitude when combined with a vision

it is the outlook that is most likely to get people to dream of a better world, work for change, and produce results

It inspires others to work with you

## Closing Thoughts

Joanna Macy suggests that if we're successful in navigating this transition future generations will speak of this as the time of the **Great Turning**.

“We are in fact privileged to live in the most exciting moment of creative opportunity in the whole of the human experience.”

- David Korten

David Korten's book “The Great Turning” has been the inspiration for much of this work.

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(These charts are available on my blog)