

Energy and Climate

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Limits ...



We live on a finite world, with finite space, with finite resources

Limits Prophets have been wrong before

- **Malthus (1766 – 1834)** – predicted that population would grow faster than food production
- **Limits to Growth (1970's to Present)** – studied the interactions of population, pollution, resources etc.
- **Oil Crisis Energy Doomers (1970's – 1980's)** – had dire projections for economic growth

But we Have Hit Limits in the Past ...

- Easter Island (was densely forested)



But we Have Hit Limits in the Past ...

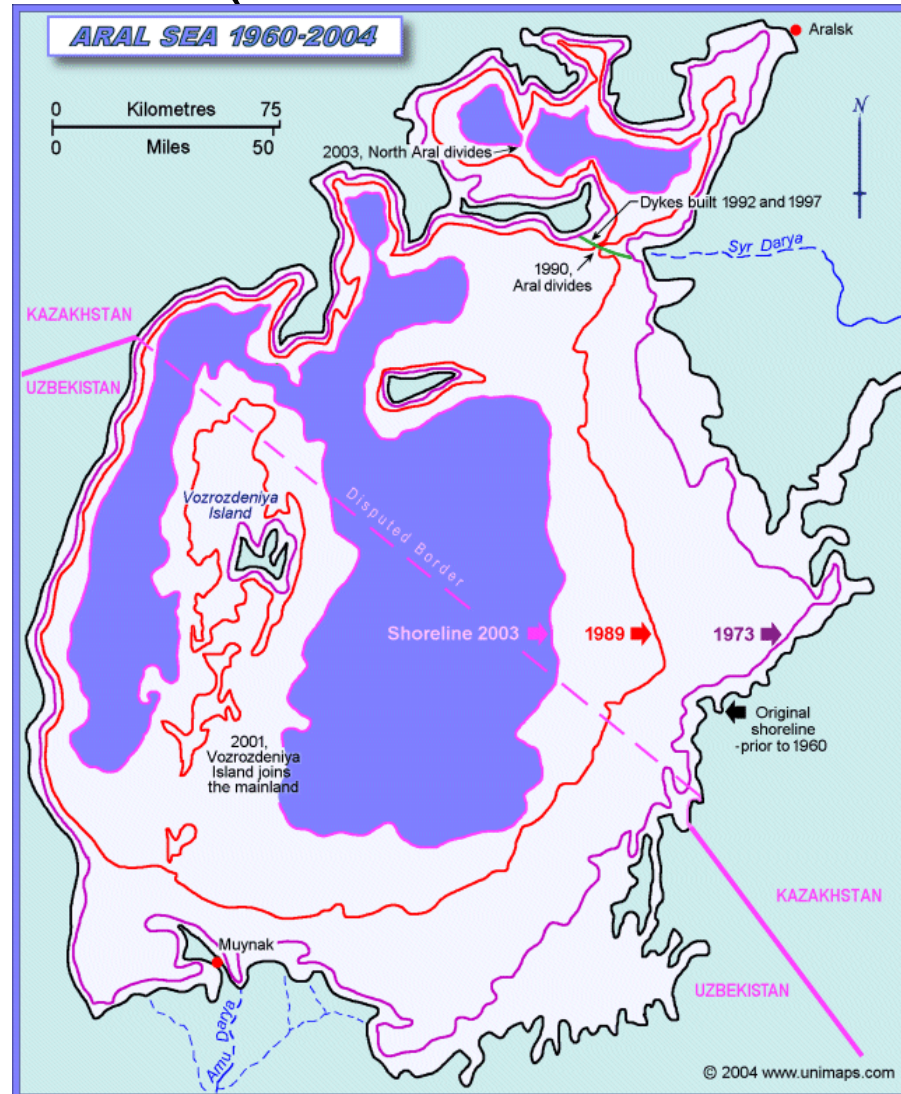
- Fertile Crescent

(was fertile)



But we Have Hit Limits in the Past ...

- Aral Sea (was the size of Lake Superior!)



But we Have Hit Limits in the Past ...

- Mesopotamia (used to grow crops)



But we Have Hit Limits in the Past ...

- The Land of Milk and Honey (had rich soil)



What is *not* Limited

Many things do not have inherent limits:

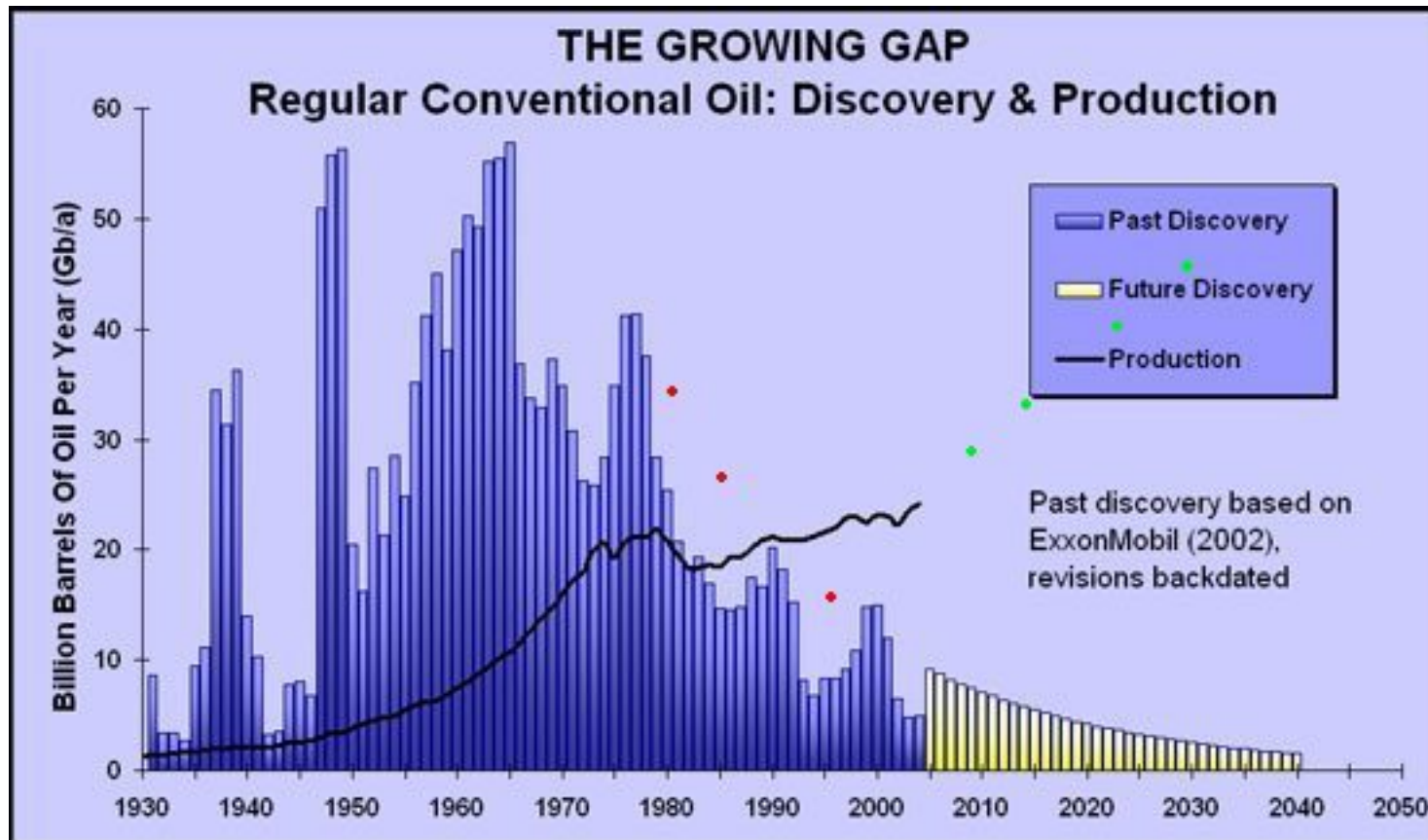
- Love
- Hope
- Faith
- Money (!!!)
- Technological Progress
- Human Ingenuity

What *is* Limited

However many physical things, measured in atoms, are limited:

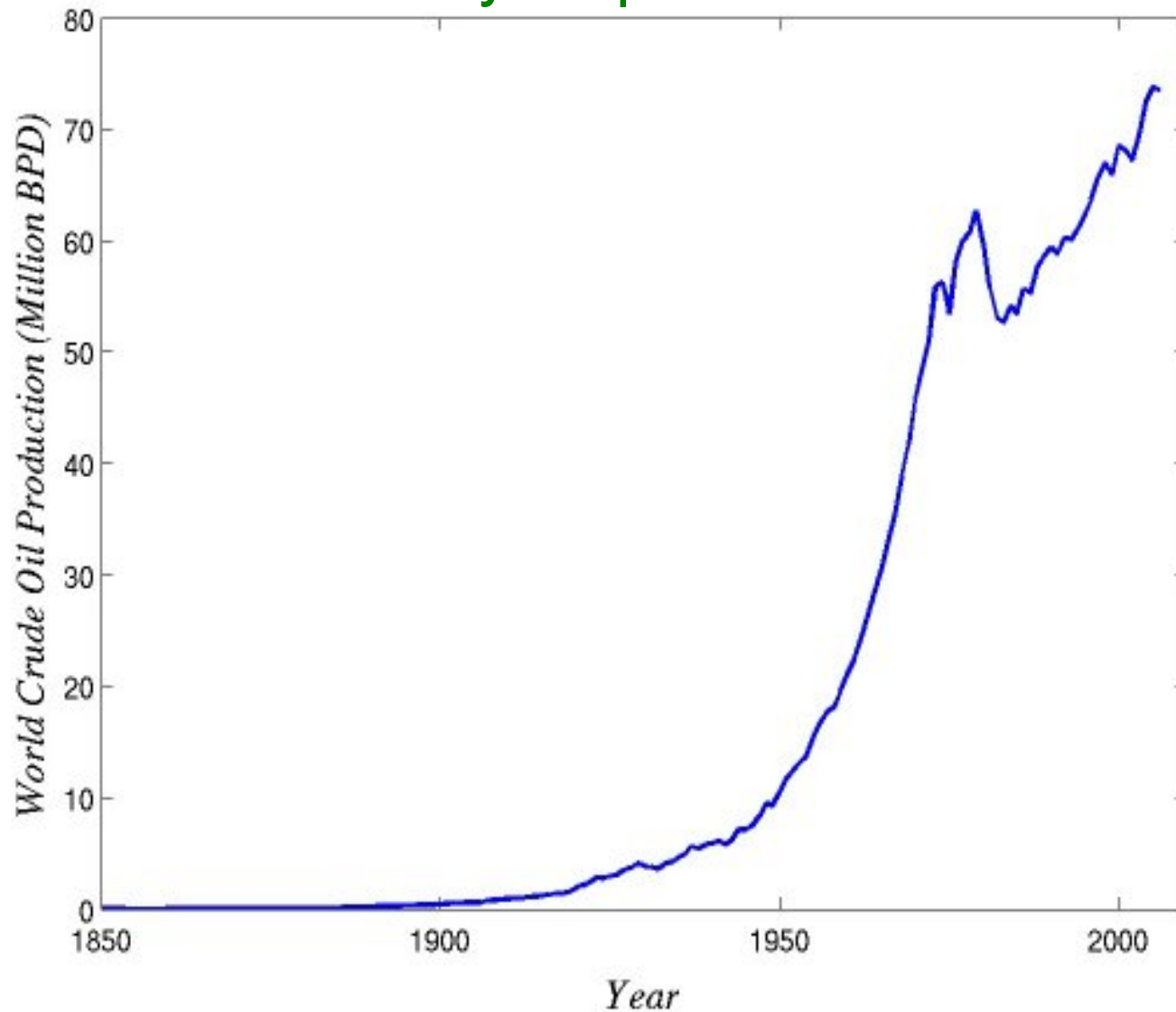
- Arable Land, Potassium, Phosphorus
- Fossil Fuels: Crude Oil, Natural Gas, Coal
- Uranium
- Surface Water
- Carbon-Dioxide Sinks, Pollution Sinks
- Minerals, metals, semiconductor elements

Limits on Energy (Oil)



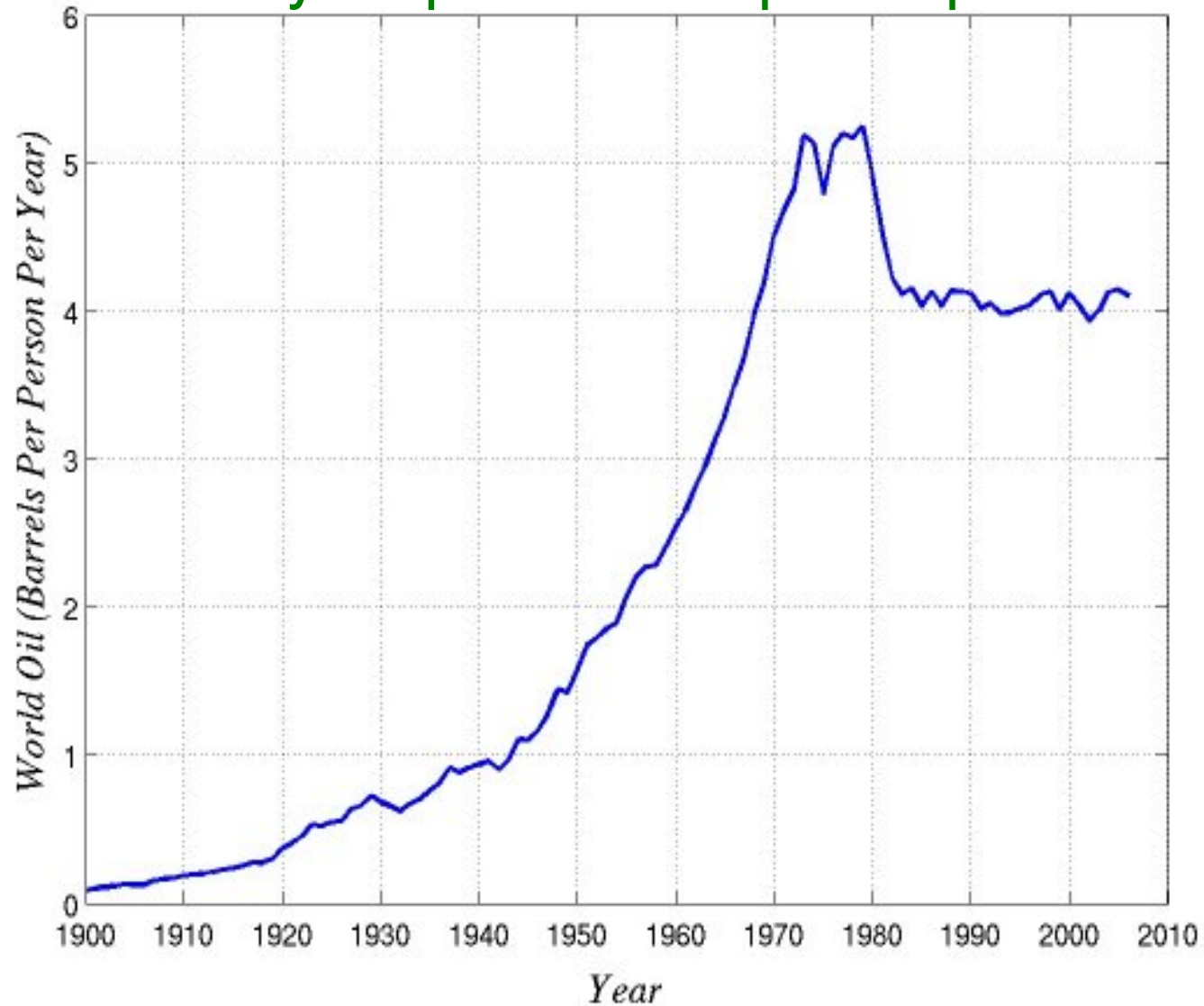
Limits on Energy (Oil)

Yearly oil production

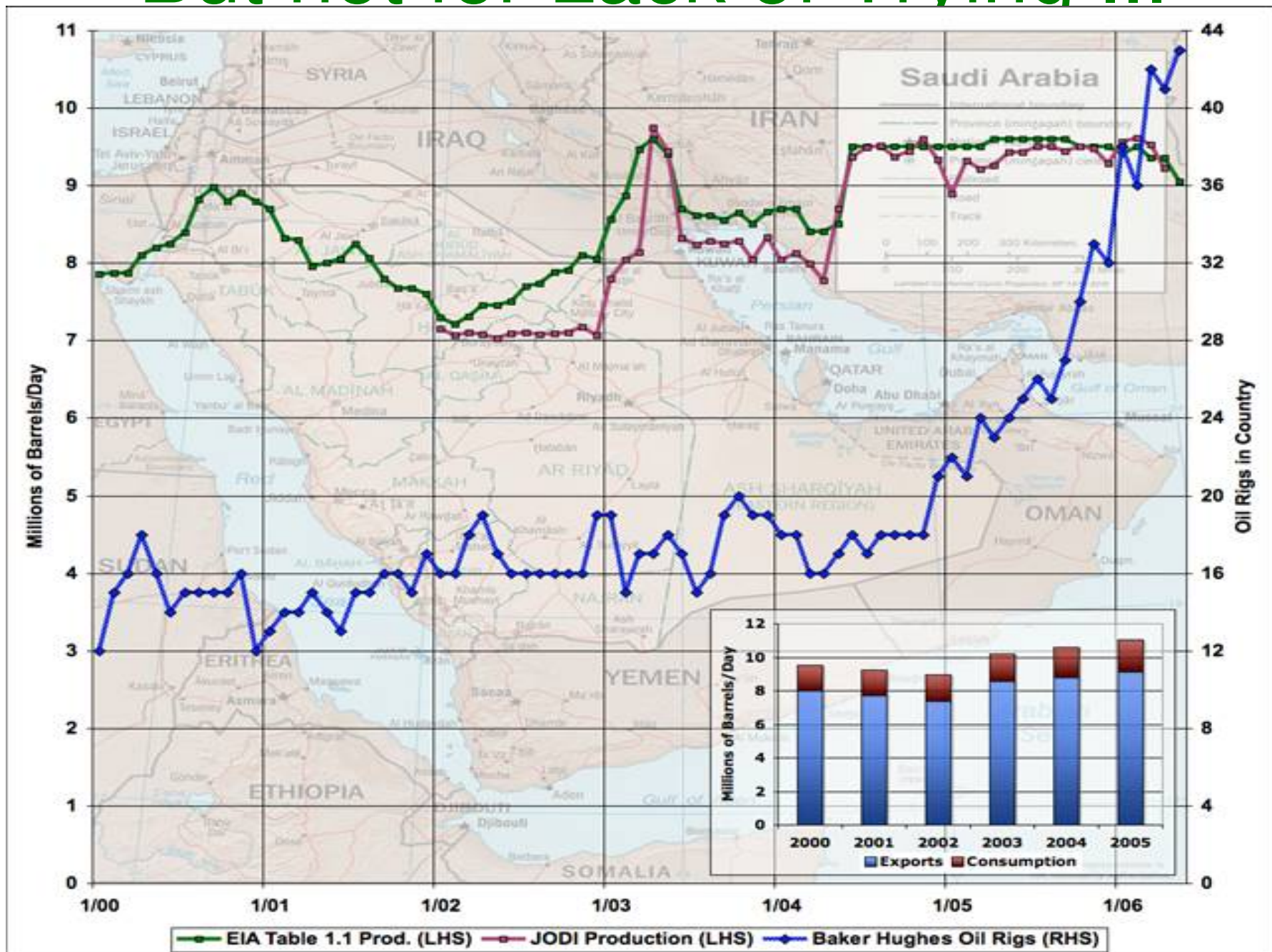


Limits on Energy (Oil)

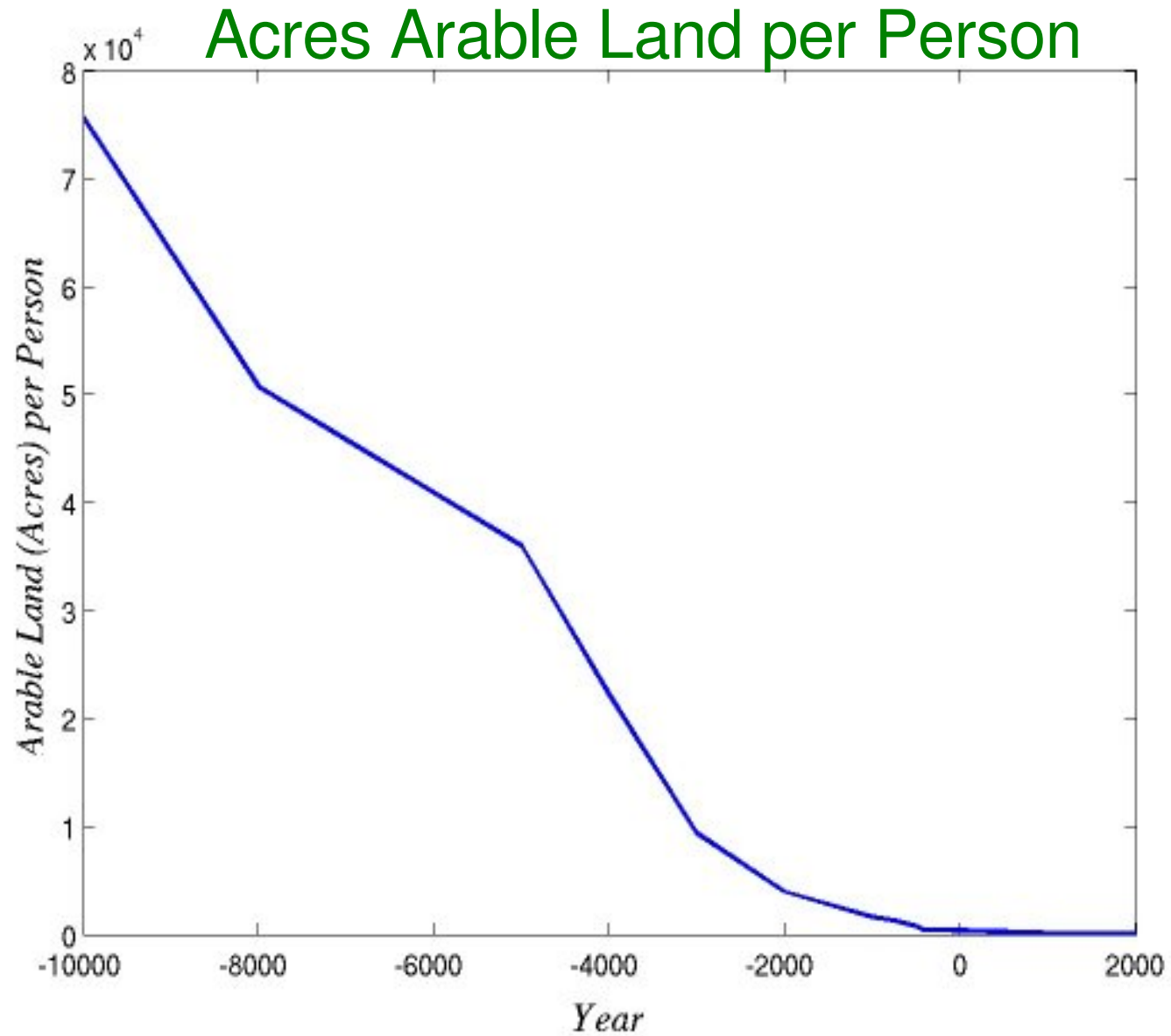
Yearly oil production per capita



But not for Lack of Trying ...

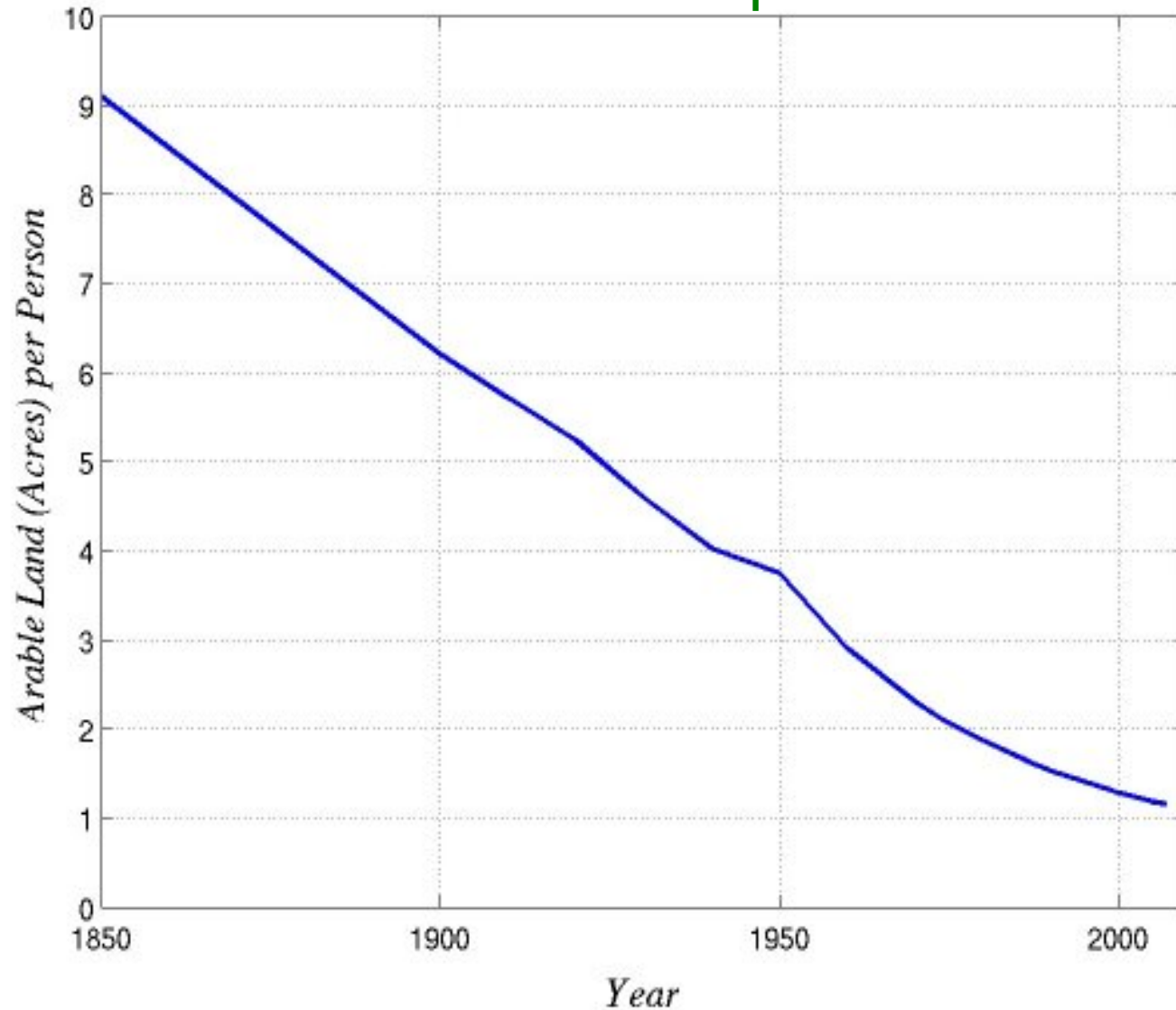


Limits on Land (Arable)



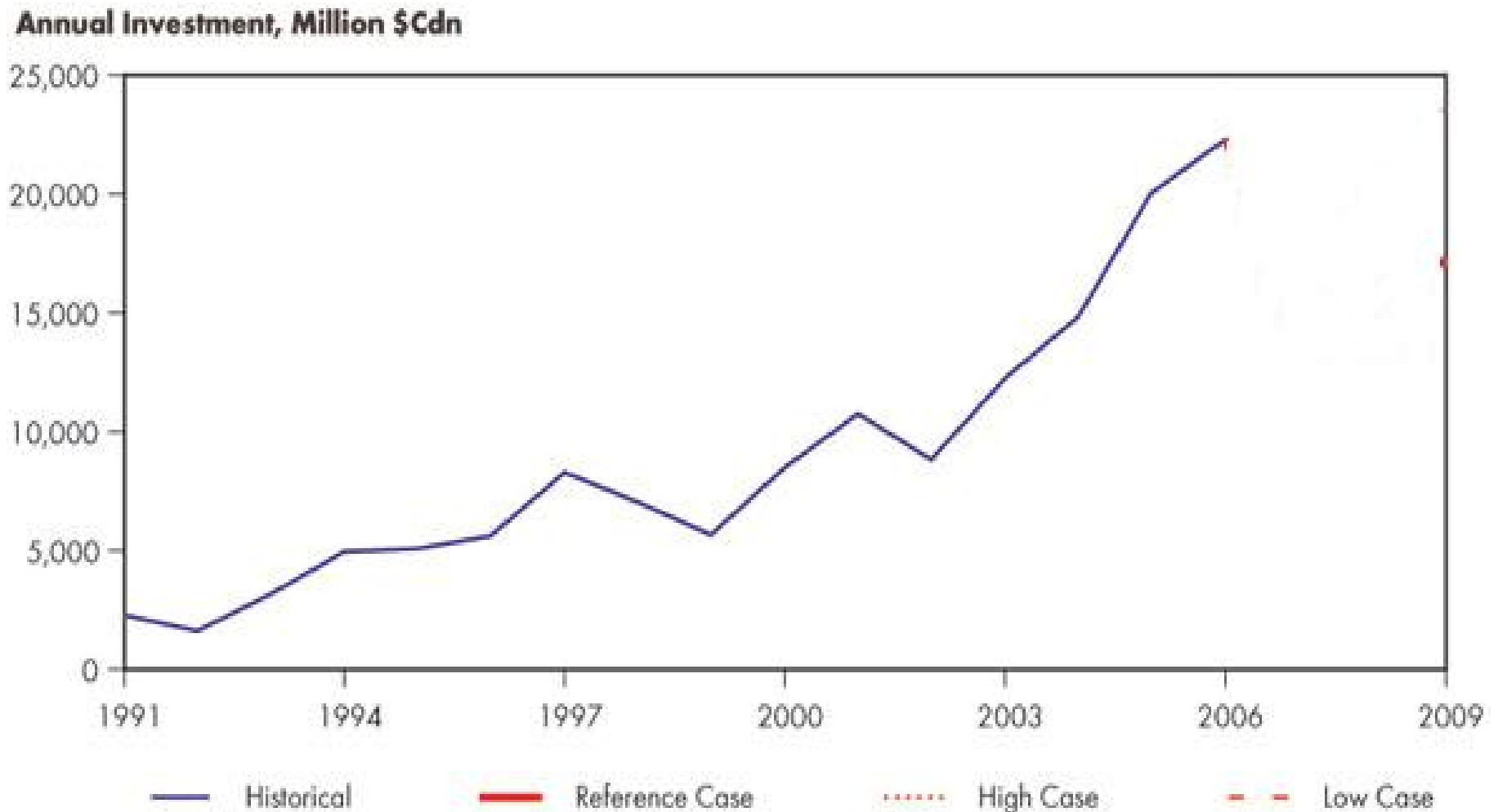
Limits on Land (Arable)

Acres Arable Land per Person



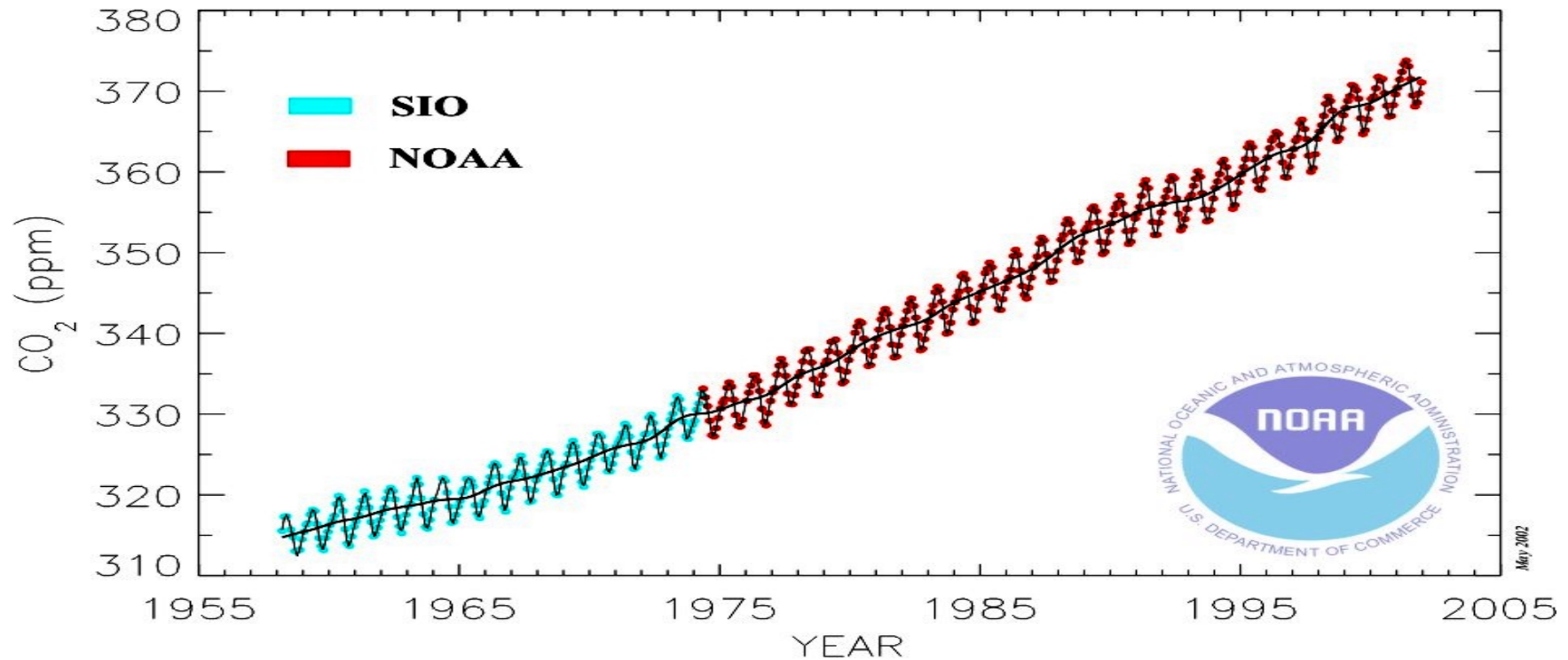
Limits on Energy (Gas)

Natural Gas Investment, but with Constant Production Rate:



Limits on Atmospheric Carbon Sinks

Mauna Loa Monthly Mean Carbon Dioxide



Atmospheric carbon dioxide monthly mean mixing ratios. Data prior to May 1974 are from the Scripps Institution of Oceanography (SIO, blue), data since May 1974 are from the National Oceanic and Atmospheric Administration (NOAA, red). A long-term trend curve is fitted to the monthly mean values. Principal investigators: Dr. Pieter Tans, NOAA CMDL Carbon Cycle Greenhouse Gases, Boulder, Colorado, (303) 497-6678, ptans@cmdl.noaa.gov, and Dr. Charles D. Keeling, SIO, La Jolla, California, (616) 534-6001, cdkeeling@ucsd.edu.

Limits & Ecosystem Change

If we exceed the limits of a finite system, we begin to destroy the system.

We can temporarily exceed the limits, but we are living off capital, eroding future limits.

This phenomenon is known as *overshoot*, followed by a *reduced carrying capacity*.

Limits & Ecosystem Change

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Similarly our response to climate change needs to include more than “just” carbon reduction, although this is an essential step.

Limits & Ecosystem Change

Global Warming has entered mainstream ...

Climate Change



Climate Change

Positive proof of global warming.



**18th
Century**

1900

1950

1970

1980

1990

Limits & Ecosystem Change

Focusing the debate on global warming is convenient for governments and corporations:

1. Issue is long term – no need to act today
2. Issue is complex and with some uncertainty

(Exxon funds scientists \$10,000 willing to write articles against climate change)

3. Ignores other human-driven catastrophes

Our response?

- A. Precautionary principle – act despite uncertainty!
- B. Need a broad response, departure from status-quo

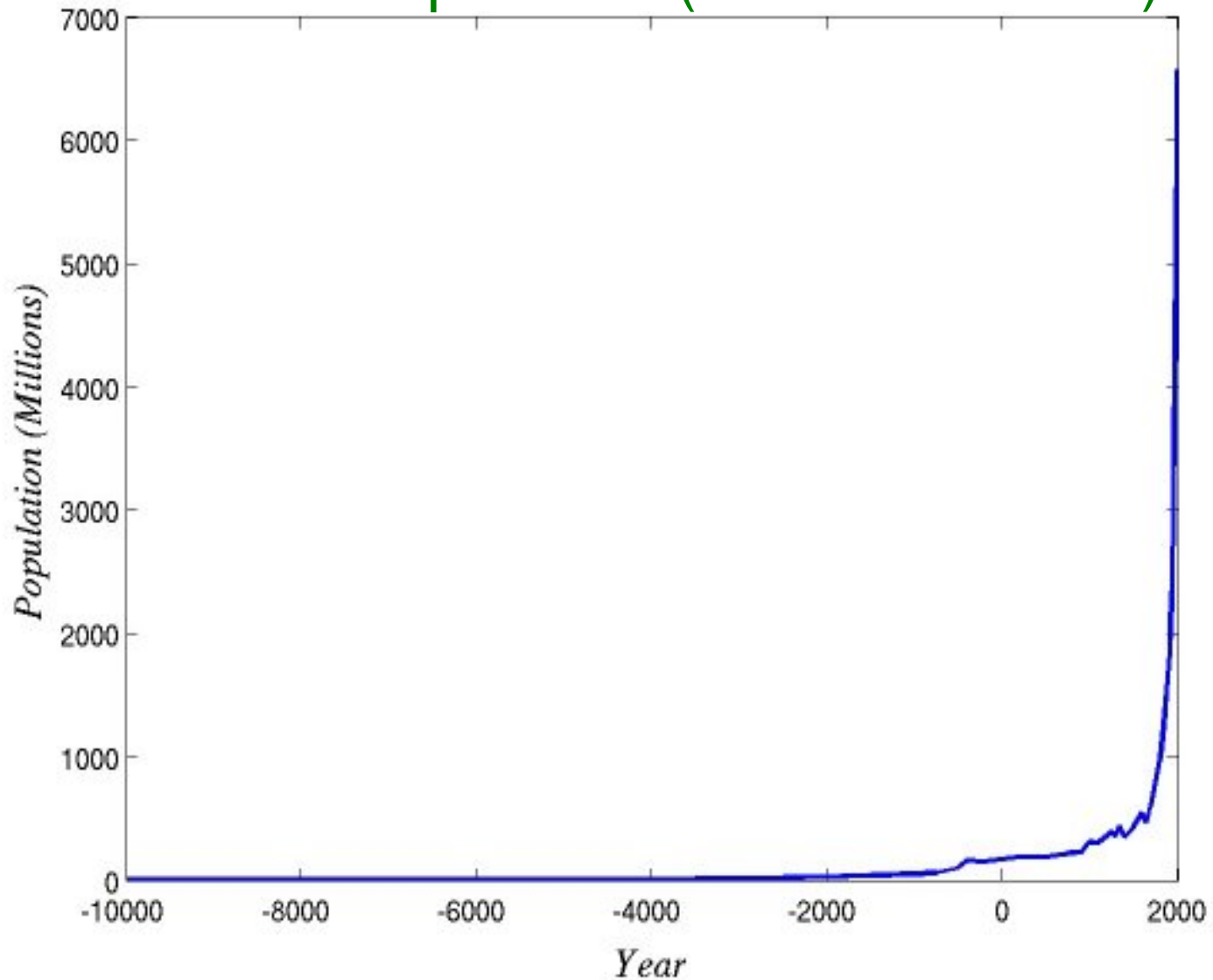
Limits & Ecosystem Change

In what ways do people push the limits of the planetary ecosystem?

How does carrying capacity or biological overshoot manifest itself?

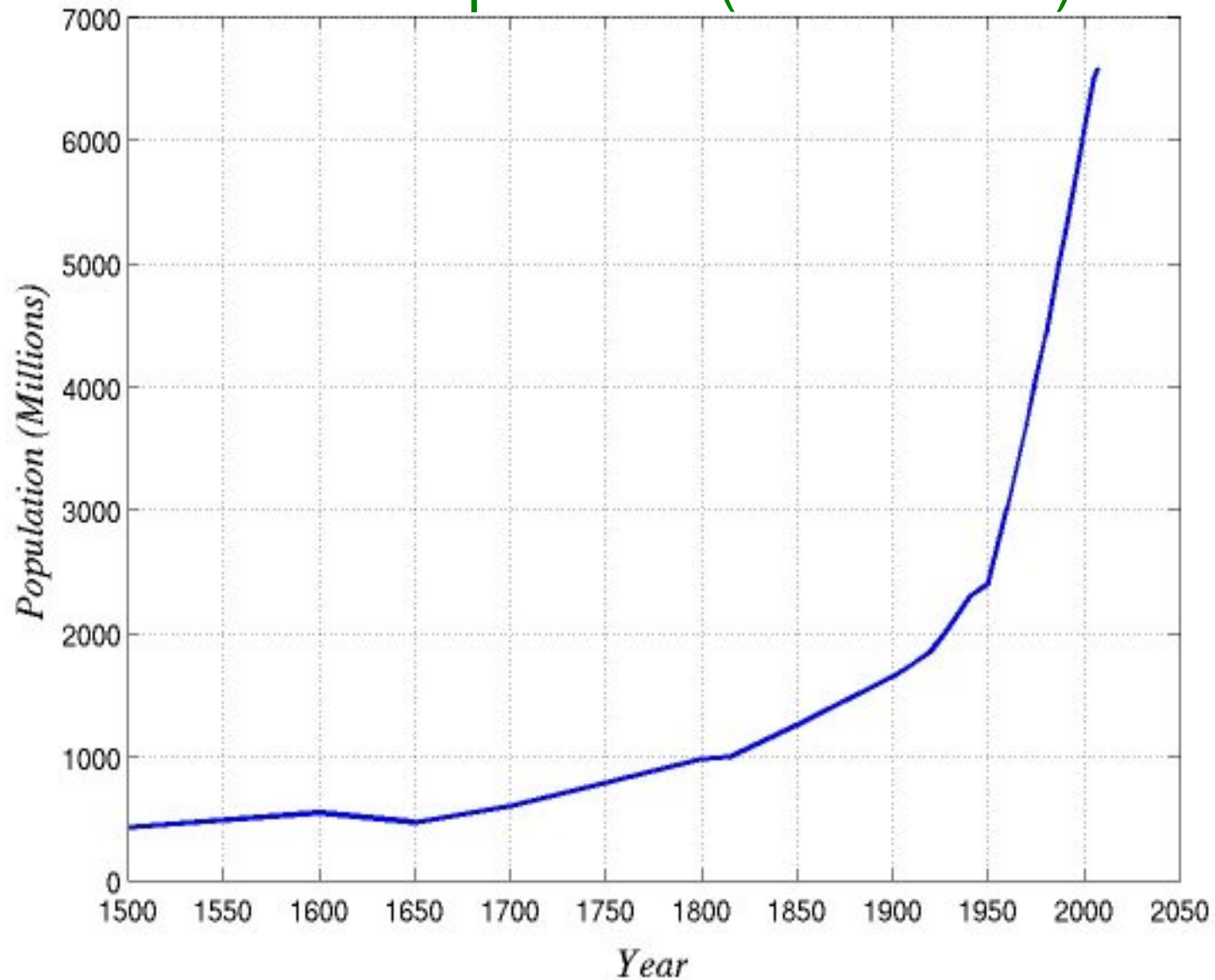
Population Defying Limits!

World Population (since 10000BC)



Population Defying Limits!

World Population (since 1500)

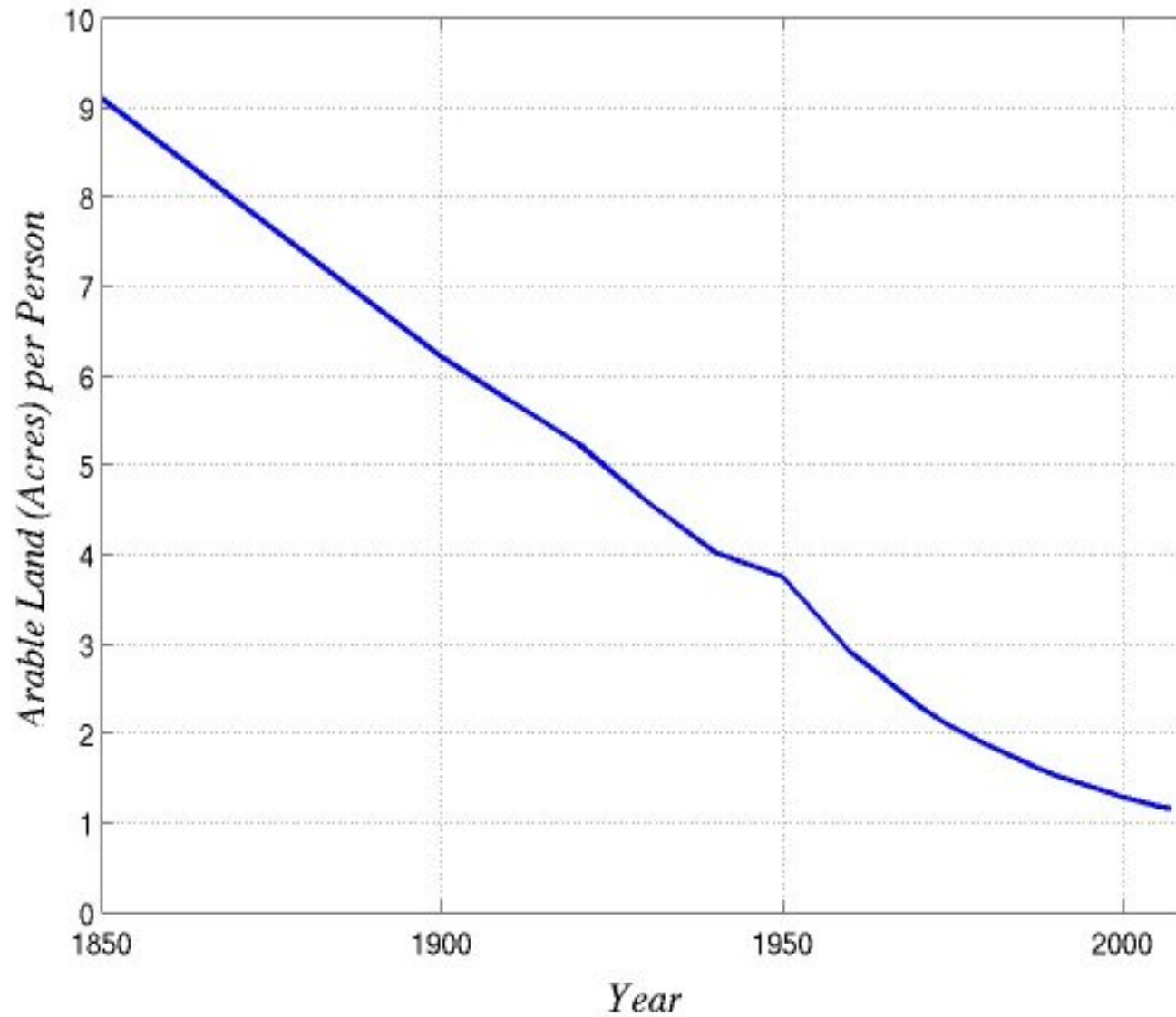


Limits & Ecosystem Change

1. Limited Arable Land ...

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Limits & Ecosystem Change

1. Limited Arable Land ... Increased Energy Use

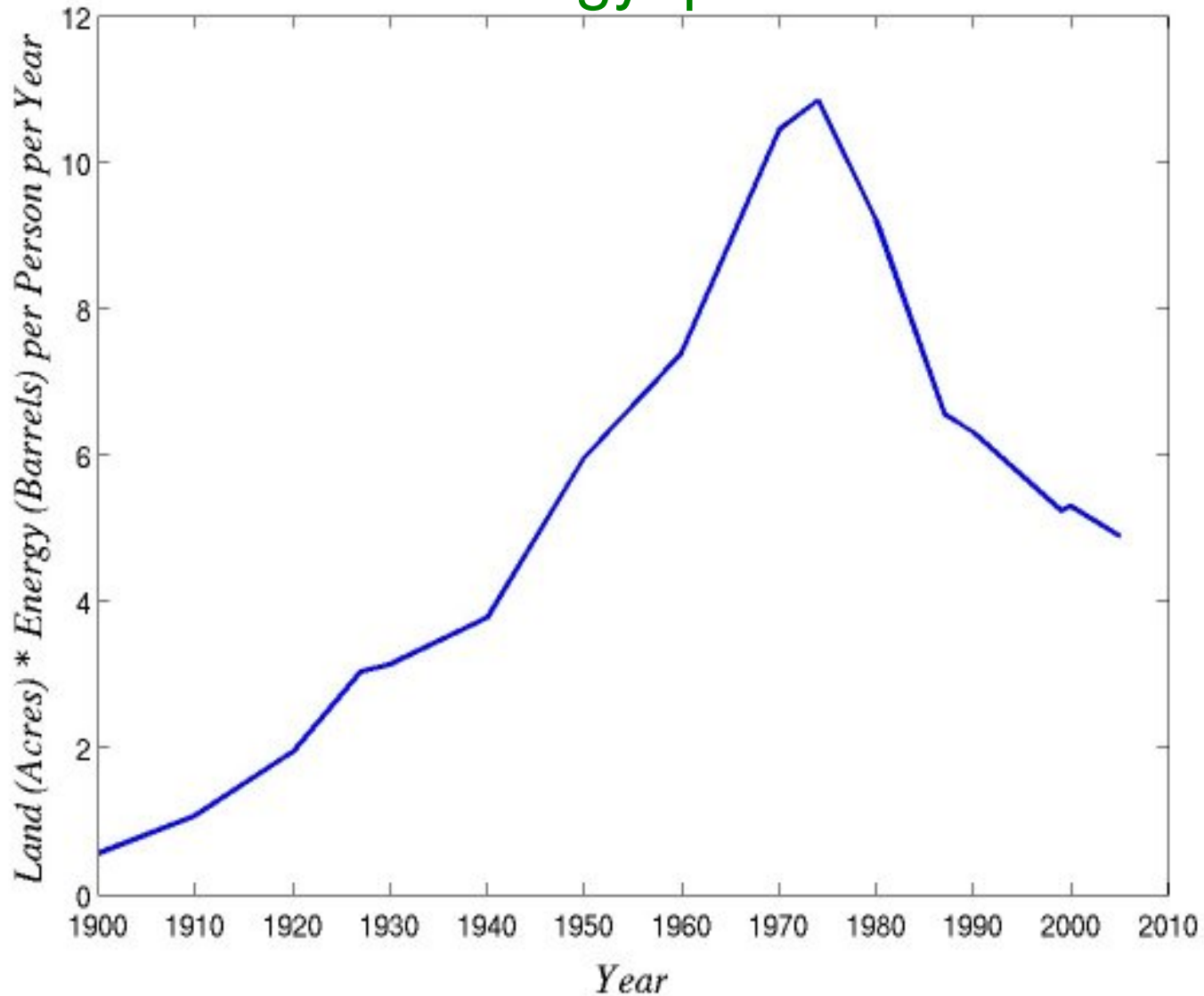
The Green Revolution is largely due to fertilization / pest control, both heavily based on fossil fuels.

Can produce ever-increasing crop yields with ever-increasing fertilizer application.

Land – Energy Tradeoff

Land – Energy Tradeoff

Land * Energy per Person



Limits & Ecosystem Change

2. Limited Land & Energy

Look elsewhere for food sources

Fisheries depletion / collapse

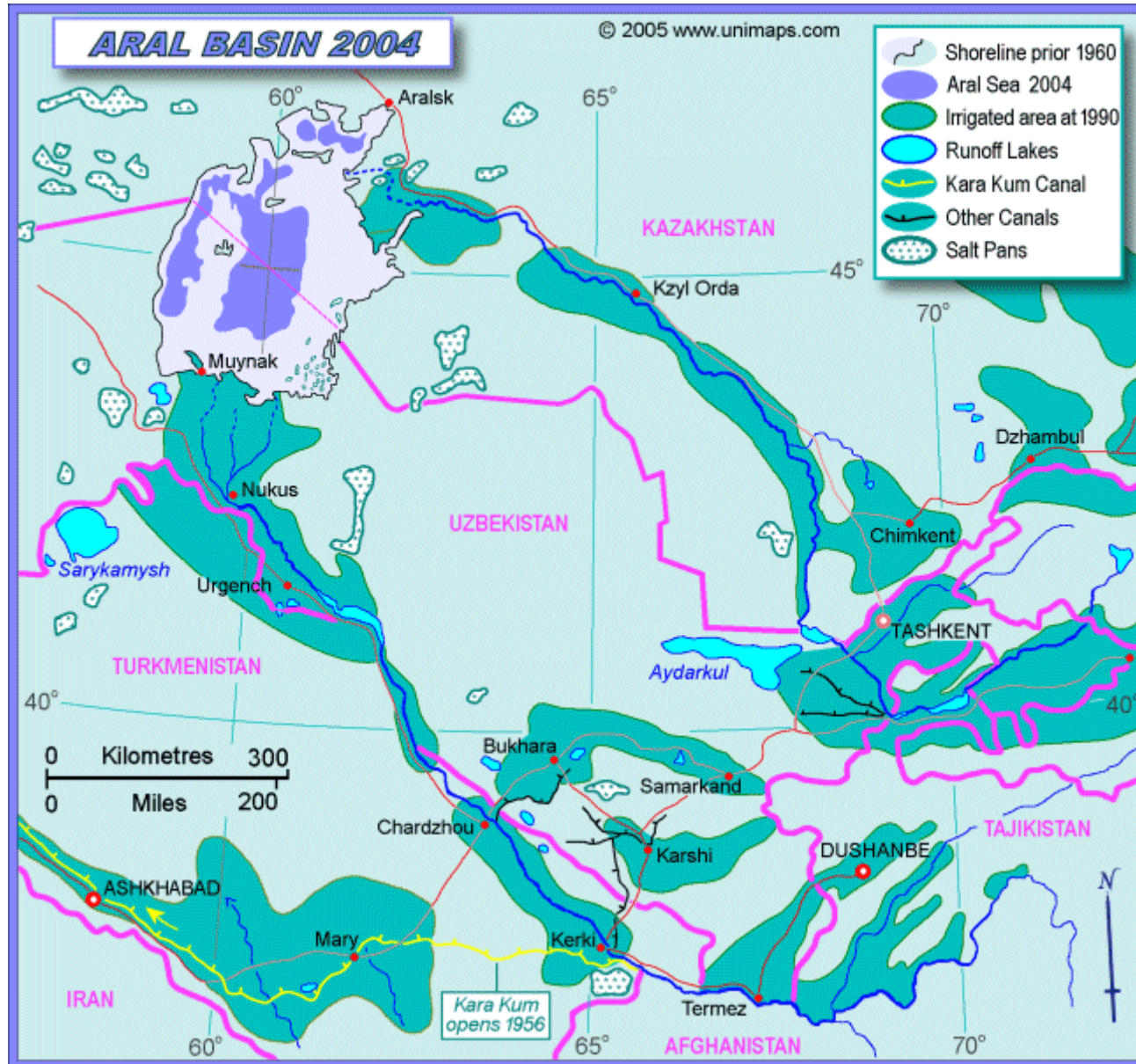
Increased irrigation

Aquifer depletion / river diversion

Increased use of dry land

Soil salination

River Diversion



Salination



Limits & Ecosystem Change

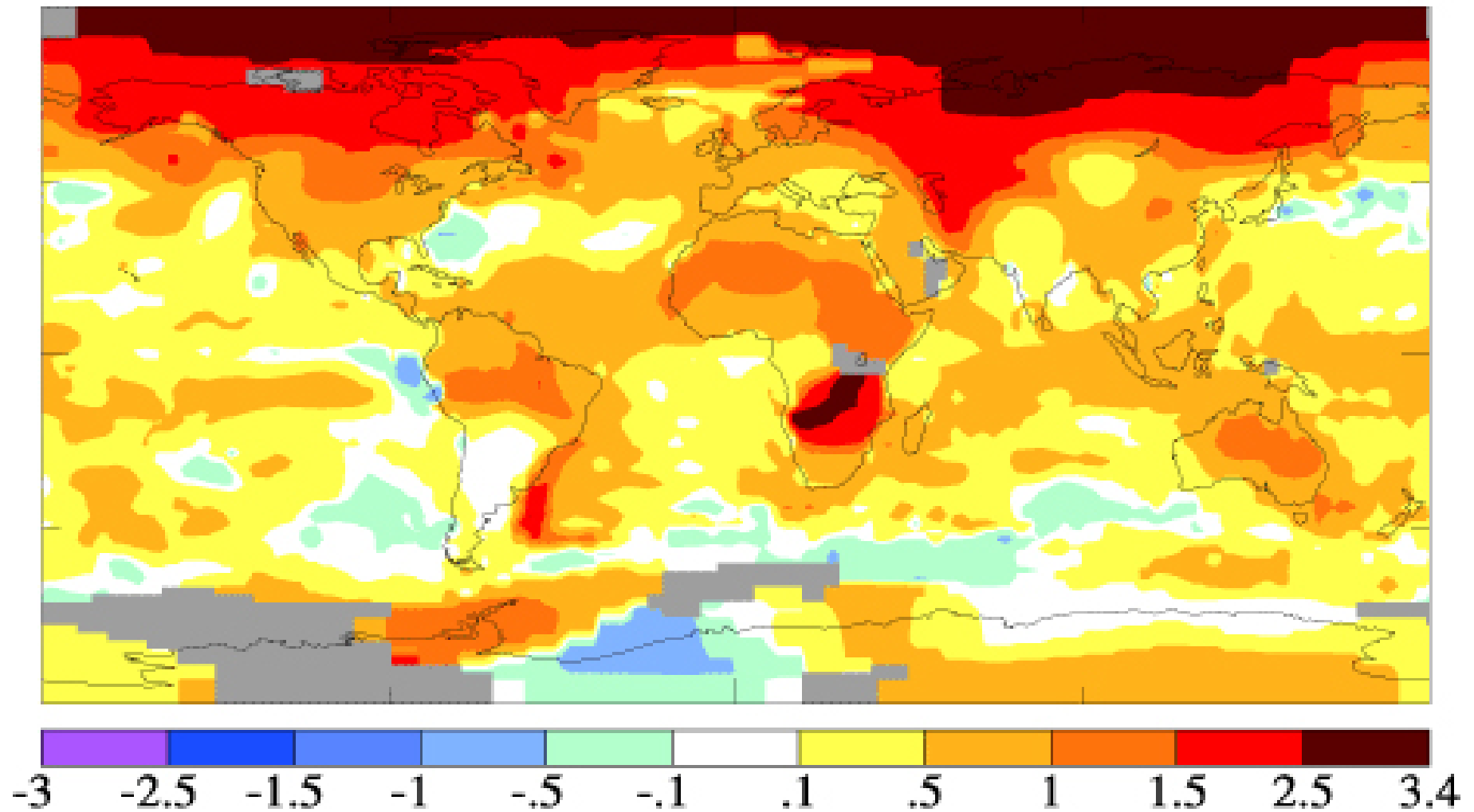
3. Limited Carbon and Pollution Sinks

Increased pollution

Acid rain, ecosystem damage

Increased warming, weather changes

Global Temperature Changes



Limits & Ecosystem Change

4. Salination + Weather Changes

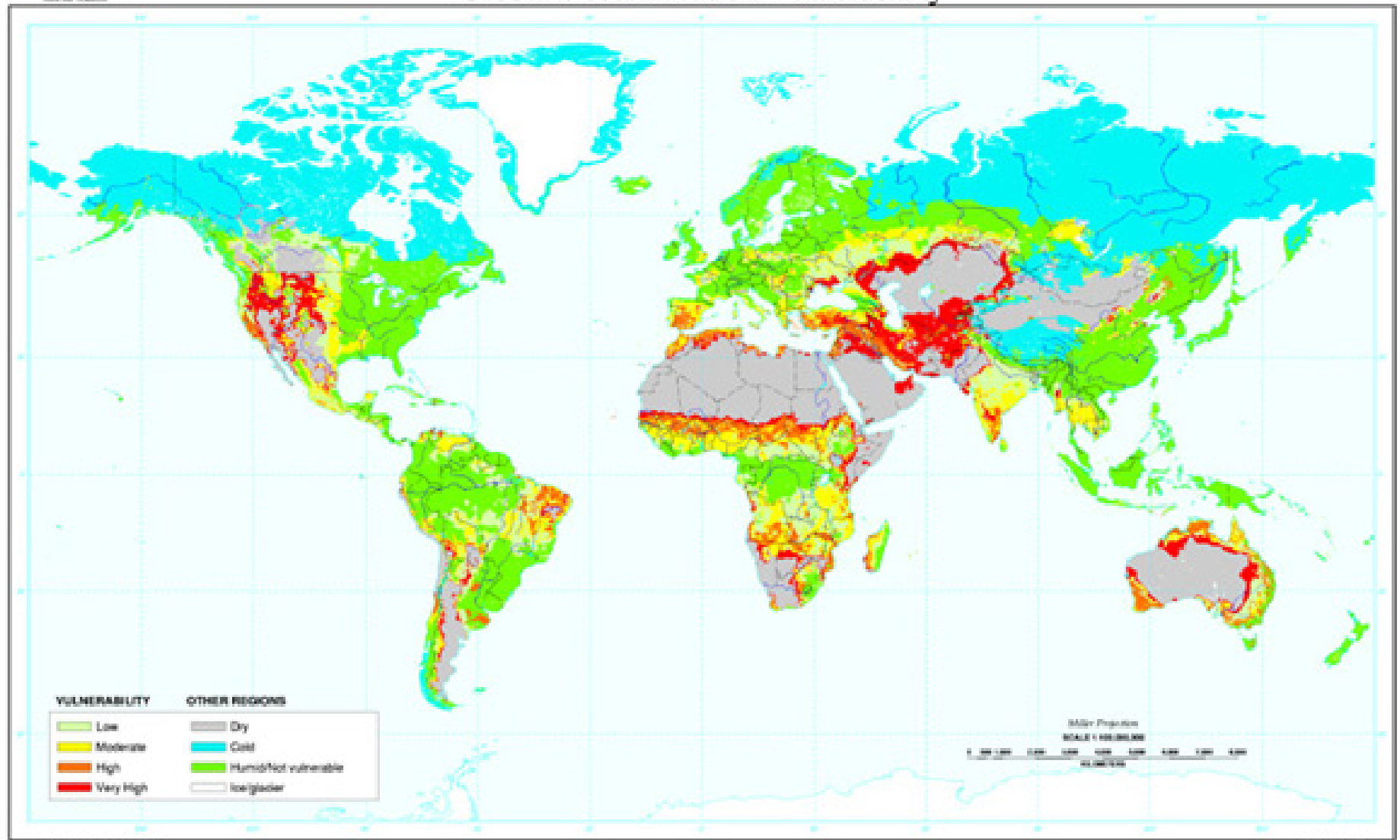
Desertification

Population Displacements

Conflict

Desertification

Global Desertification Vulnerability



Limits & Ecosystem Change

5. Limited Energy ...

To most easily avoid Western energy problems ...

1. Price developing world out of energy market
2. Ethanol (price developing world out of food)
3. Tar sands (HUGE natural gas / water requirements)
4. Coal-to-oil (HUGE carbon output)
5. Coal (carbon, mercury, strip mining ...)

economic / developmental / environmental disasters

Climate Change

OK, so I'll work hard to reduce my energy usage:

- Turn the thermostat down
- Buy an energy efficient furnace
- Buy a smaller car

These are attempts to preserve *status quo*,

Tweaking our lifestyle to avoid significant change.

If soil erosion / crop failures / coal binge takes place, status quo is gone. We will need massive, radical change.

Energy / Climate / Conflict

To Think About: (1/6)

It can no longer be possible to limit the examination of our lifestyle to the local environment.

To discuss or contemplate peace-making, in the absence of taking a very hard look at our energy use and lifestyle, is either naive or hypocritical.

If you don't cut your energy use, which of the economic / developmental / environmental disasters

Energy / Climate / Conflict

To Think About: (2/6)

- The Stewardship of Creation:
 - We are hitting the limits of the world we have been given
 - What are God's expectations for our stewardship?
- Go Amish or Go Noam Chomsky: The Western lifestyle has major impacts, worldwide.
 - Go Amish: live locally and see your impact
 - Go Noam Chomsky: live globally, but be aware (hard!)

Energy / Climate / Conflict

To Think About: (3/6)

– Upside-Down Kingdom:

- Poor subsistence farmer in warm, third-world climate, vs
- Rich, globalized, highly-dependent first-world worker

– The Meek Shall Inherit:

- Living at peace with the earth means doing & having less
- North America uses A LOT more than its fair share! Why are we happy to justify and perpetuate this system?

Energy / Climate / Conflict

To Think About: (4/6)

– Cheap Energy:

- It is hard to take action – energy is still dirt cheap
- Noah built his ark while the weather was still dry ...

– Out of Sight, Out of Mind:

- Many poor countries have already suffered a “peak oil”
- Why do we want to take action only now that it might actually affect us?

Energy / Climate / Conflict

To Think About: (5/6)

- The Genius of Western Development:
 - The high GNP and apparent productivity of Western countries is due to the leverage of cheap energy.
 - Every previous energy source built the next one:
 - Human Animal Wood Coal Oil / Gas / Uranium
 - We have mostly used Oil/Gas on consumption & hedonism
 - The next energy source is not yet ready, and takes time
 - Our infrastructure is long-term, and cannot be substantially changed without a lot of energy:

Energy / Climate / Conflict

To Think About: (6/6)

– Who Blinks First ...

- Wait for wealth or military might to allocate energy?
- Wait for ecosystem to collapse before acting?

– Status Quo ...

- Should be an anachronism
- We need a fundamental shift in attitude / outlook

Energy / Climate / Conflict

What to do ... how do we live with integrity as peacemakers in a wasteful, affluent society?

- Increased awareness
- Reduction in energy consumption
- Reduced-material lifestyle, Challenge status-quo
- Support for local food production
- Support for alternative energy production
- Build strong, local communities
- Localized production, localized skills

