

The Limits to Growth: It is too late for sustainable development

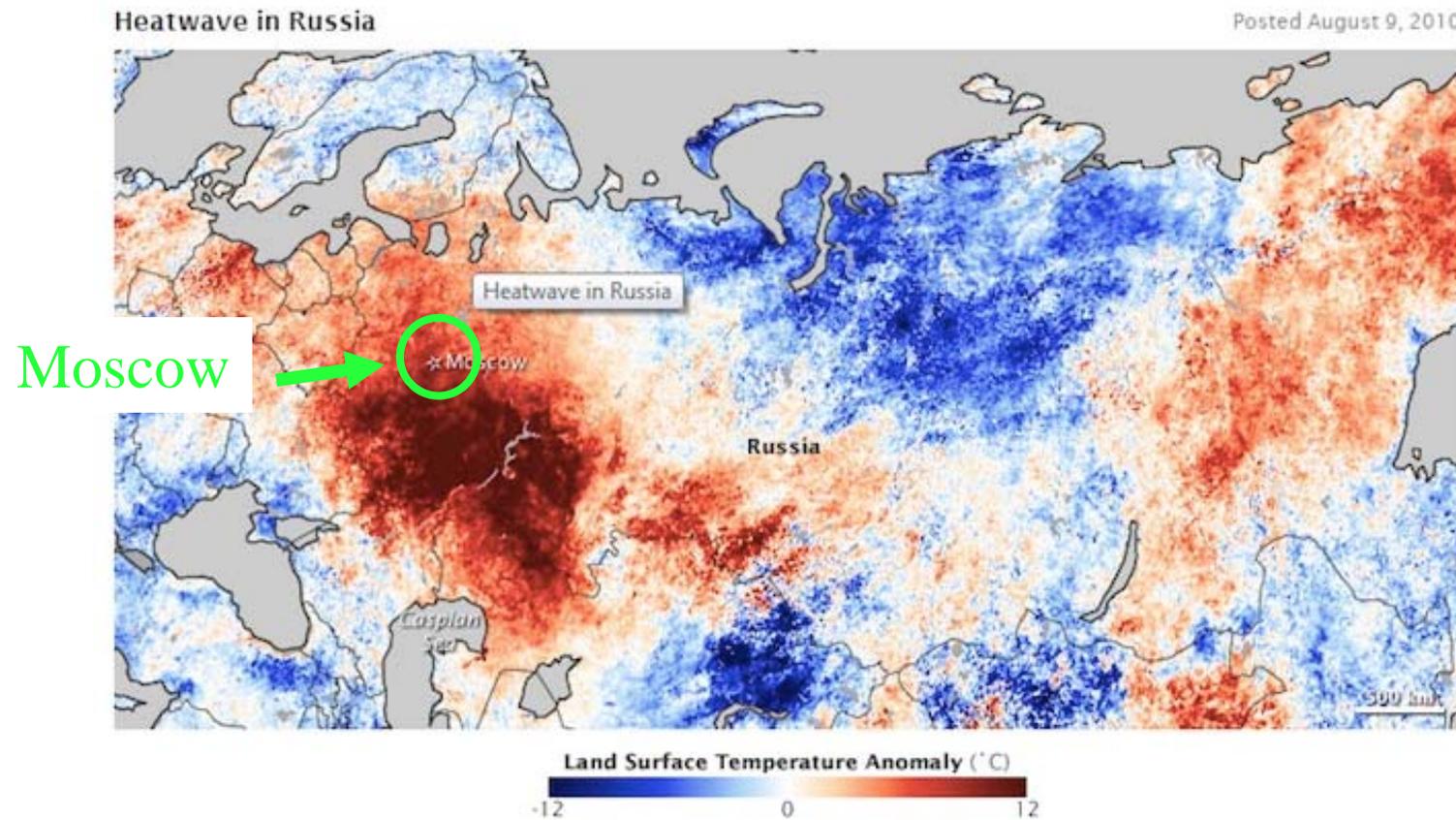
Dennis Meadows

Presentation to Moscow State University

Moscow, Russia

18 April, 2012

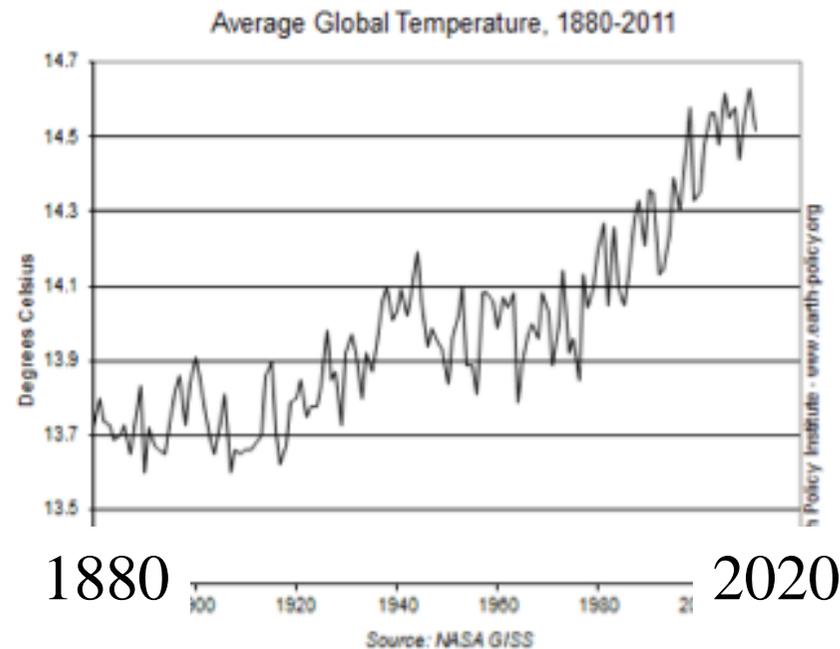
Land Temperatures in Russia – August 2010



The Globe is Becoming Warmer

The head of the state weather service, Alexander Frolov, said that the heat wave of 2010 was the worst in 1,000 years of recorded Russian history.

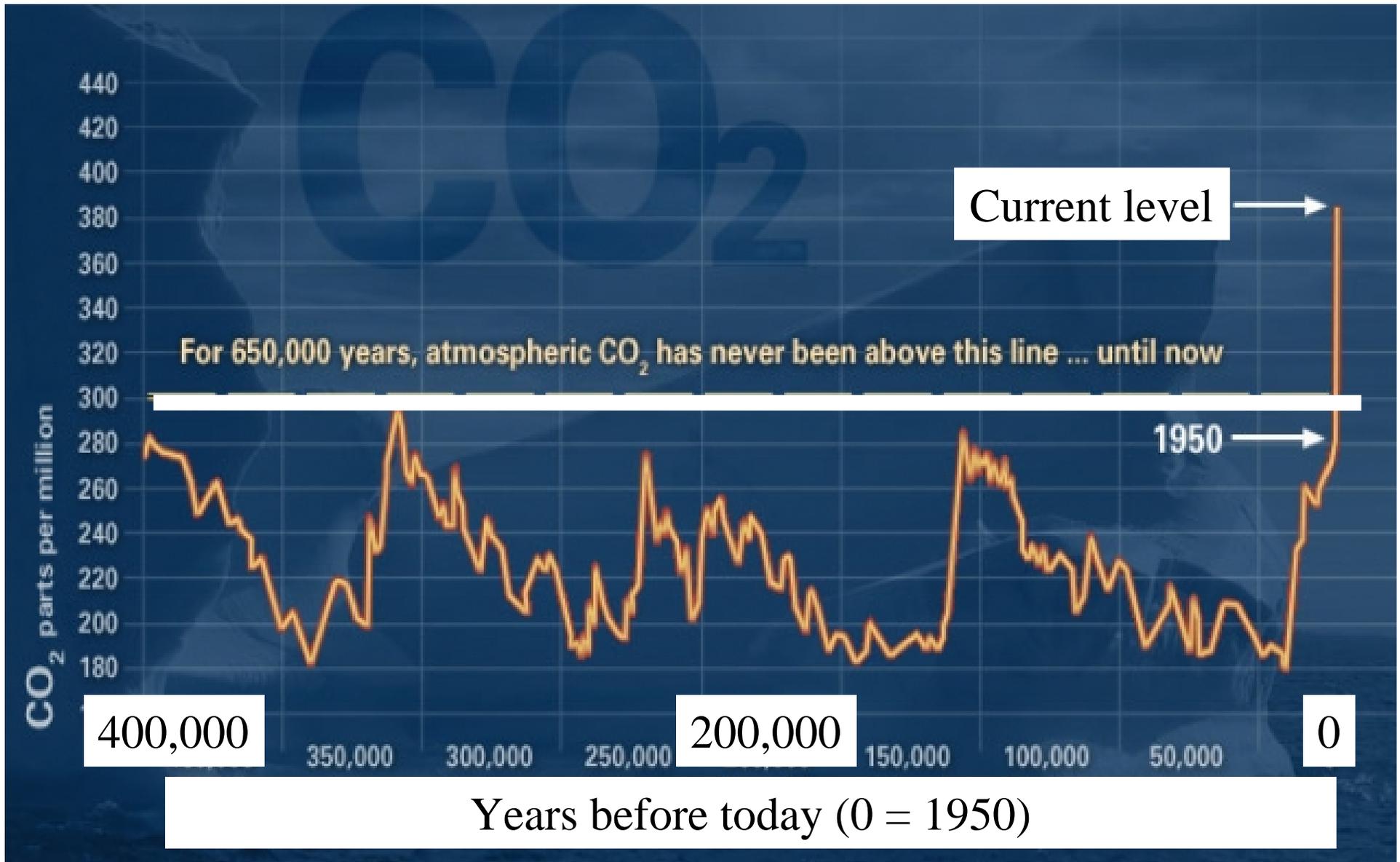
Since the 1970s, each subsequent decade has gotten hotter – and 9 of the 10 hottest years on record occurred since 2000.



Outline of My Remarks

- Facts about climate change.
- Facts about global oil production.
- Seeking resilience rather than equilibrium.
- Policies for raising resilience.

Facts About Climate Change



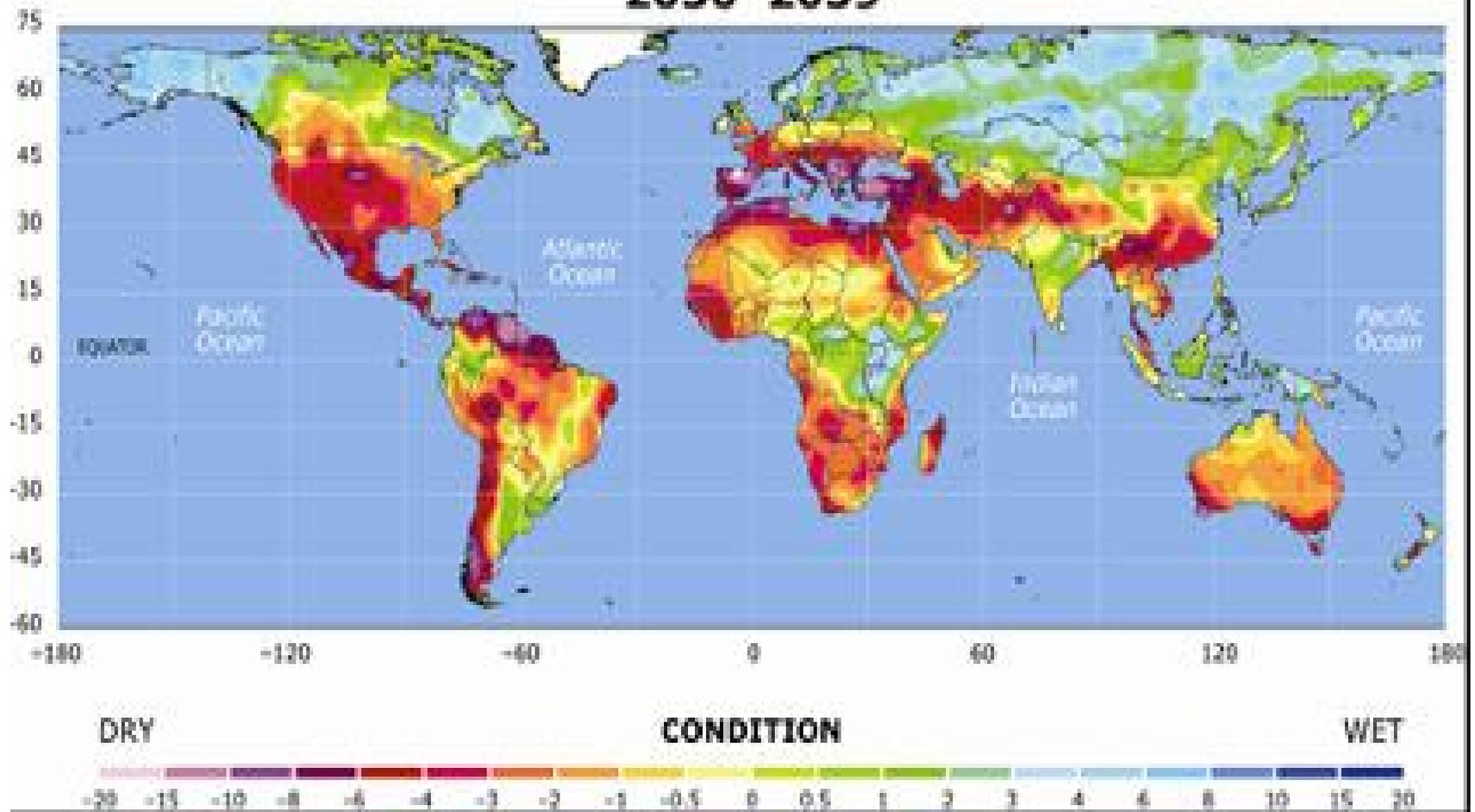
Climate Change is More Than Global Warming:

- Changes in precipitation area and intensity of fluctuations (more floods, more droughts, bigger deserts)
- Shifting ecological and cultivation zones
- Growing acidity in the ocean
- Greater instability in winds
- Migration of pests, diseases, pollinators
- Rising sea level
- Melting of permafrost
- Migration of people and industry

Precipitation is Becoming More Extreme

- Worldwide, 2010 and 2011 were the wettest years over land in recorded history.
- In the United States 7 states had their wettest year in history in 2011; several others had their driest year in recorded history.
- Arctic ice fell to its lowest volume in history in 2011.
- Western El Salvador, received nearly 1.5 meters of rain in 10 days.

2030-2039



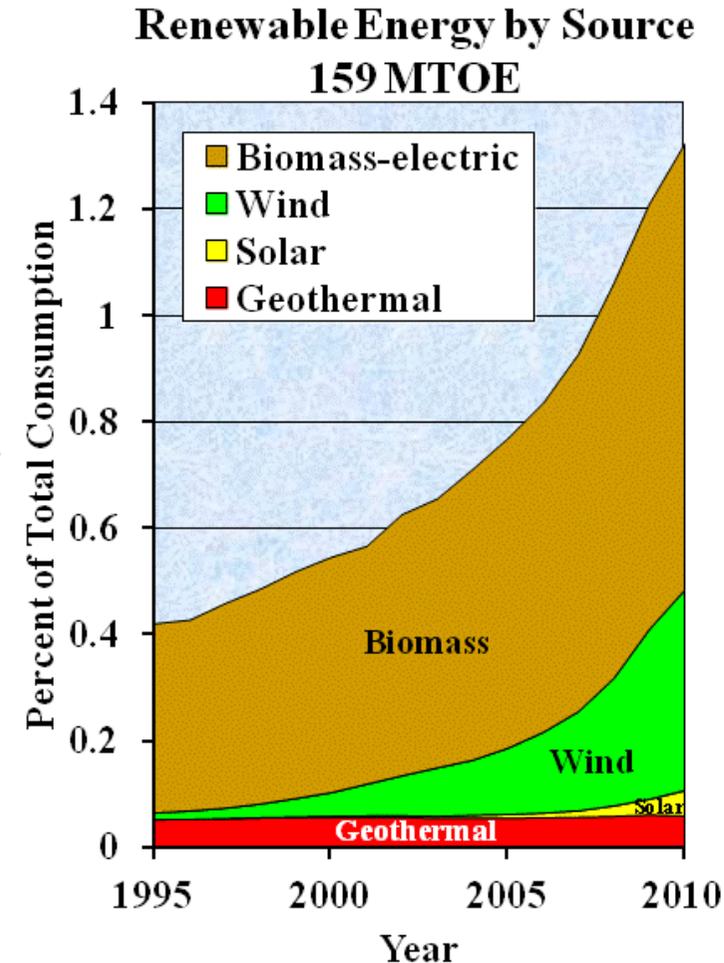
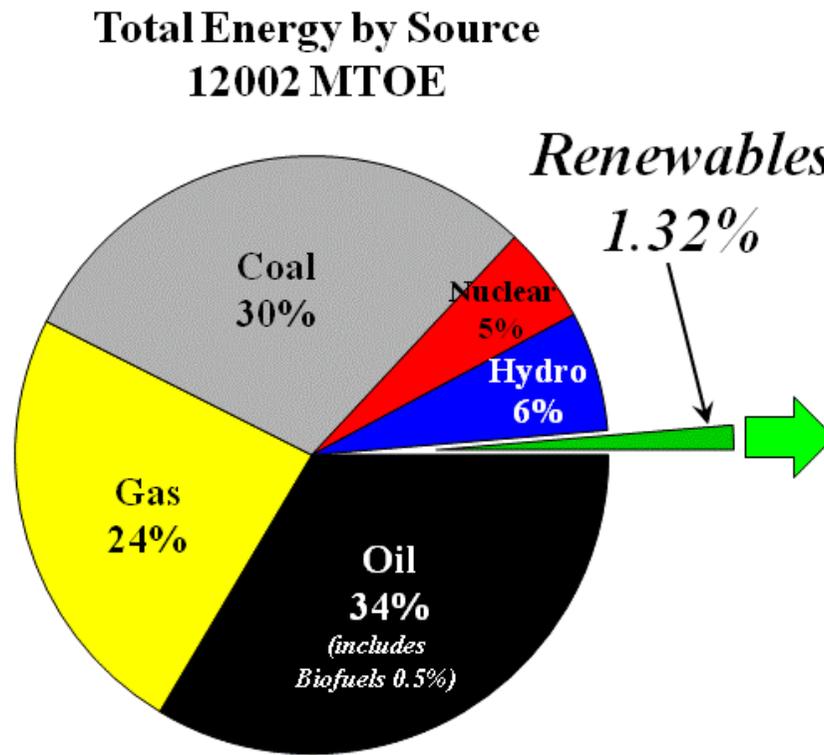
The Evolution of Climate Criticisms

- Climate is not changing.
- Climate is changing, but we are not the cause.
- We are causing climate change, but it is late to stop it.

Main Effects of Climate Change for Russia

- Reduced food production.
- Health damage (new pests).
- Migration pressure from China.
- Forest fires.
- Problems of industrial cooling.
- Structural damage on permafrost.

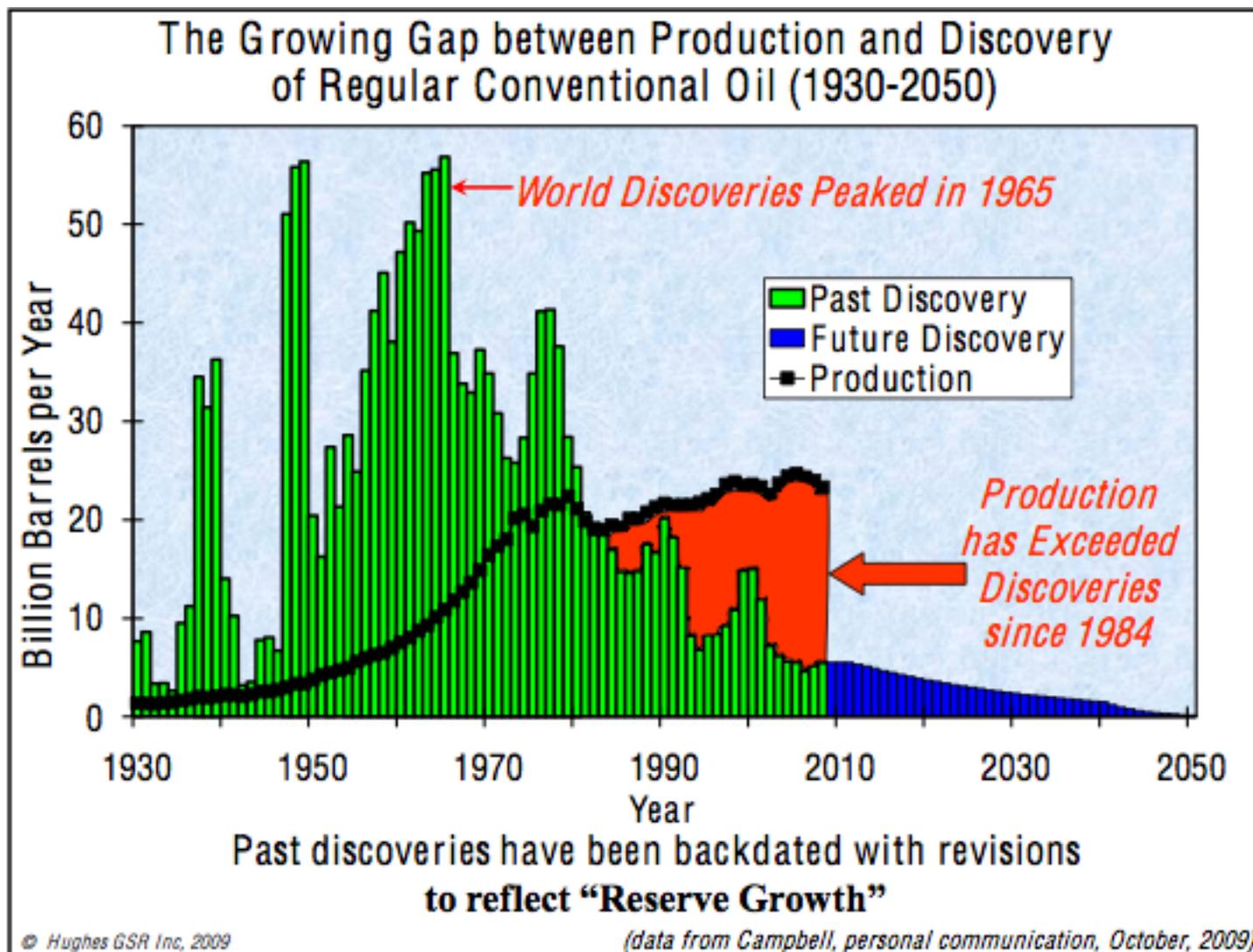
Global Primary Energy Consumption by Source in 2010 A Comparison to Total Non-Hydro Renewable* Energy



*excluding biomass burned for non-electric uses

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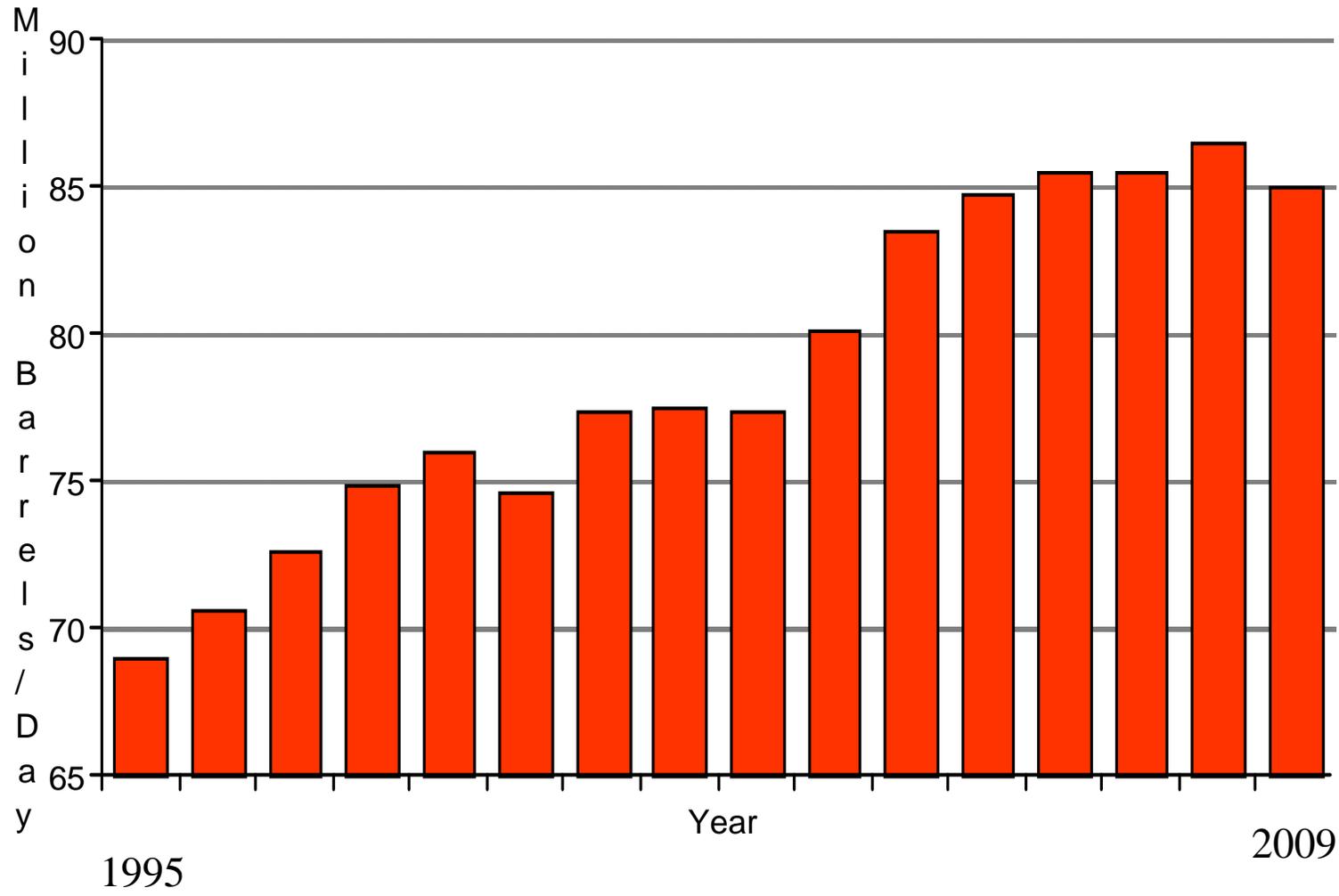
(data from BP Statistical Review of World Energy, 2011)



The Easy Oil is Gone

- Oil discoveries peaked in 1960s.
- Every year since 1984 oil consumption has exceeded oil discovery.
- In 2009 discoveries were about 5 billion barrels (bb); consumption was about 31 bb.
- Of the world's 20 largest oil fields, 18 were discovered 1917 - 1968; 2 in the 1970s; 0 since.

Global Oil Production



Global Oil Production is Nearing the End of its Plateau

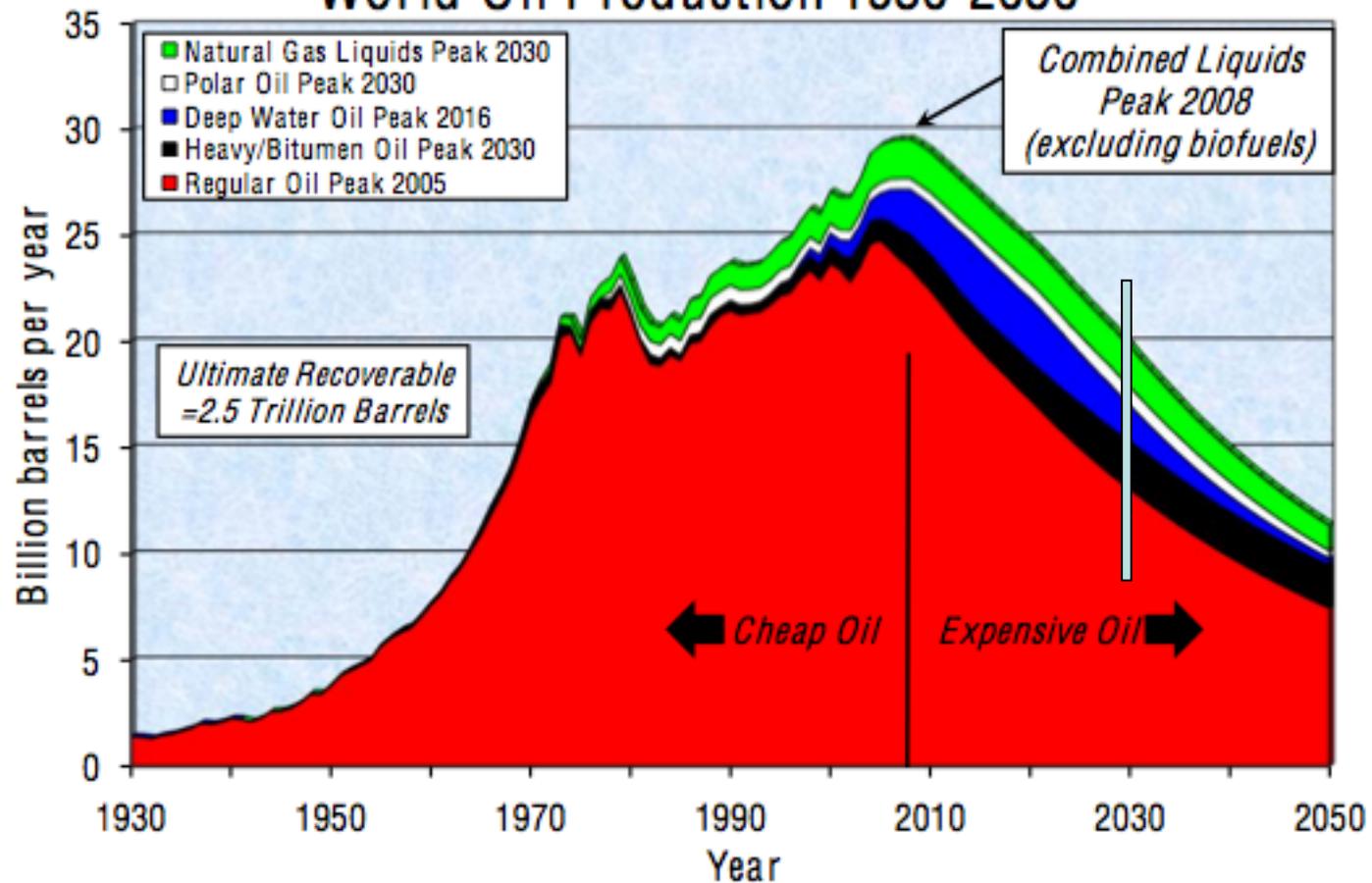
- 1995 - 1999 + 5.5%
- 2000 - 2004 + 7.9 %
- 2005 - 2009 + 0.4 %

- data from the *International Statistical Supplement – 2010 edition, International Energy Agency, p. 18*

- 2010 - 2030 – 50%*

* Projection from *Crude Oil – The Supply Outlook, Energy Watch Group, Feb 2008, p. 12.*

Campbell's (2009) Base Case History and Forecast of World Oil Production 1930-2050



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(data from C.J.Campbell, personal communication, October, 2009)

Awareness is Growing that the Oil Peak Has Passed

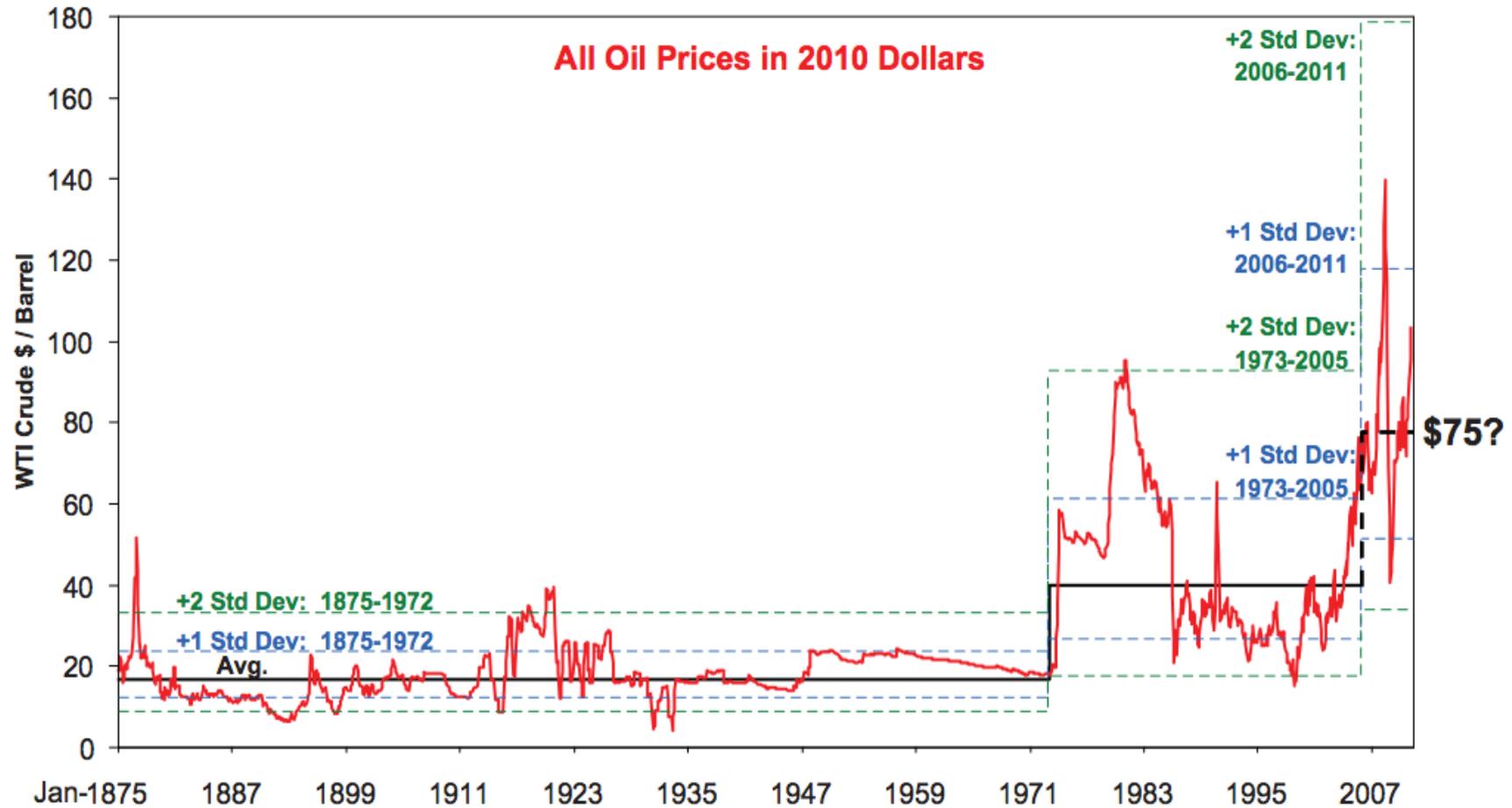
“By 2012, surplus oil production capacity could entirely disappear, and as early as 2015, the shortfall in output could reach nearly 10 MBD.”

- U S Joint Forces Command, [Joint Operating Environment Report](#), February, 2010

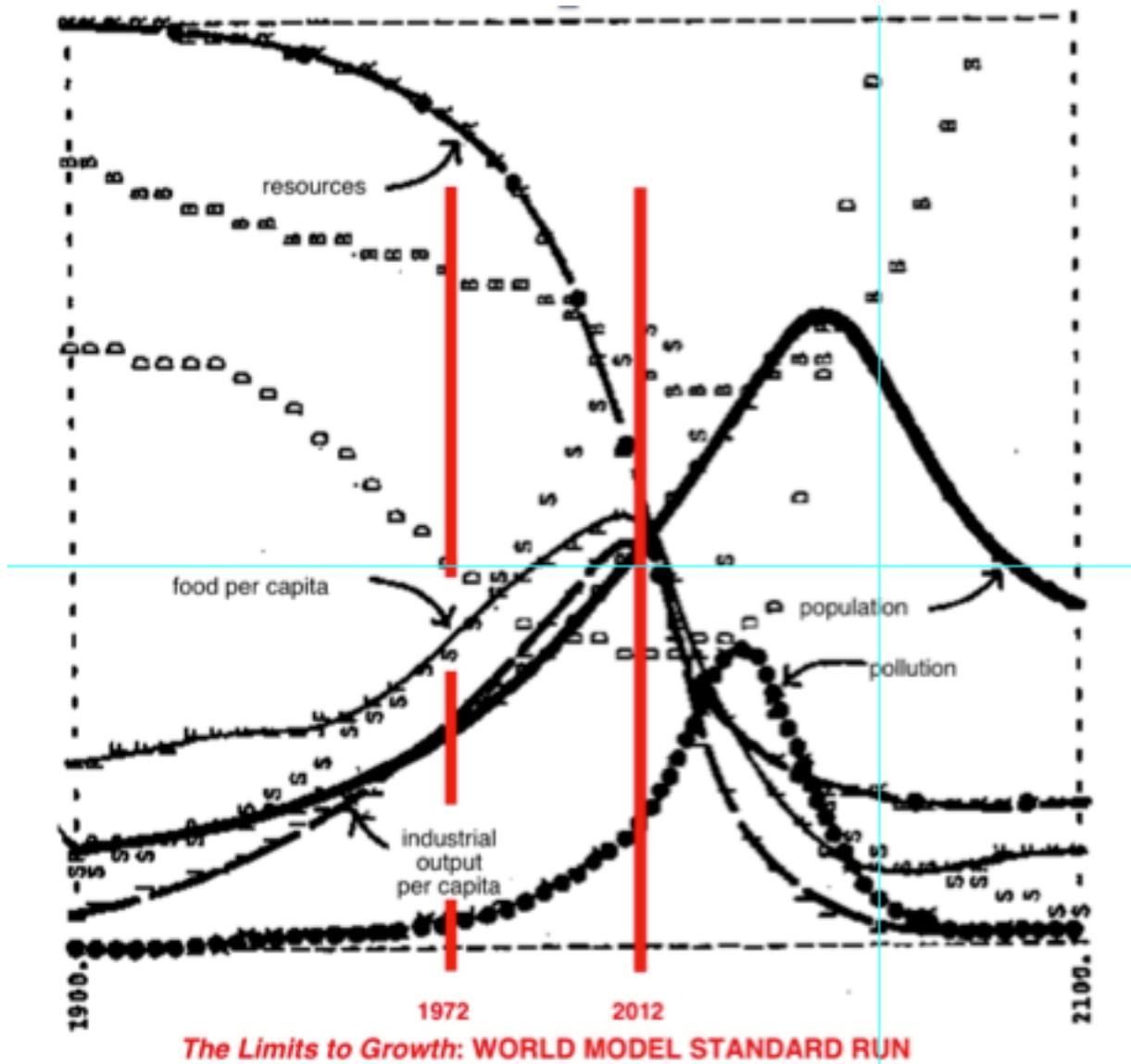
“Peak Oil Production May Already be Here,”

- [Science](#), p. 1510, Vol 331, March 25, 2011

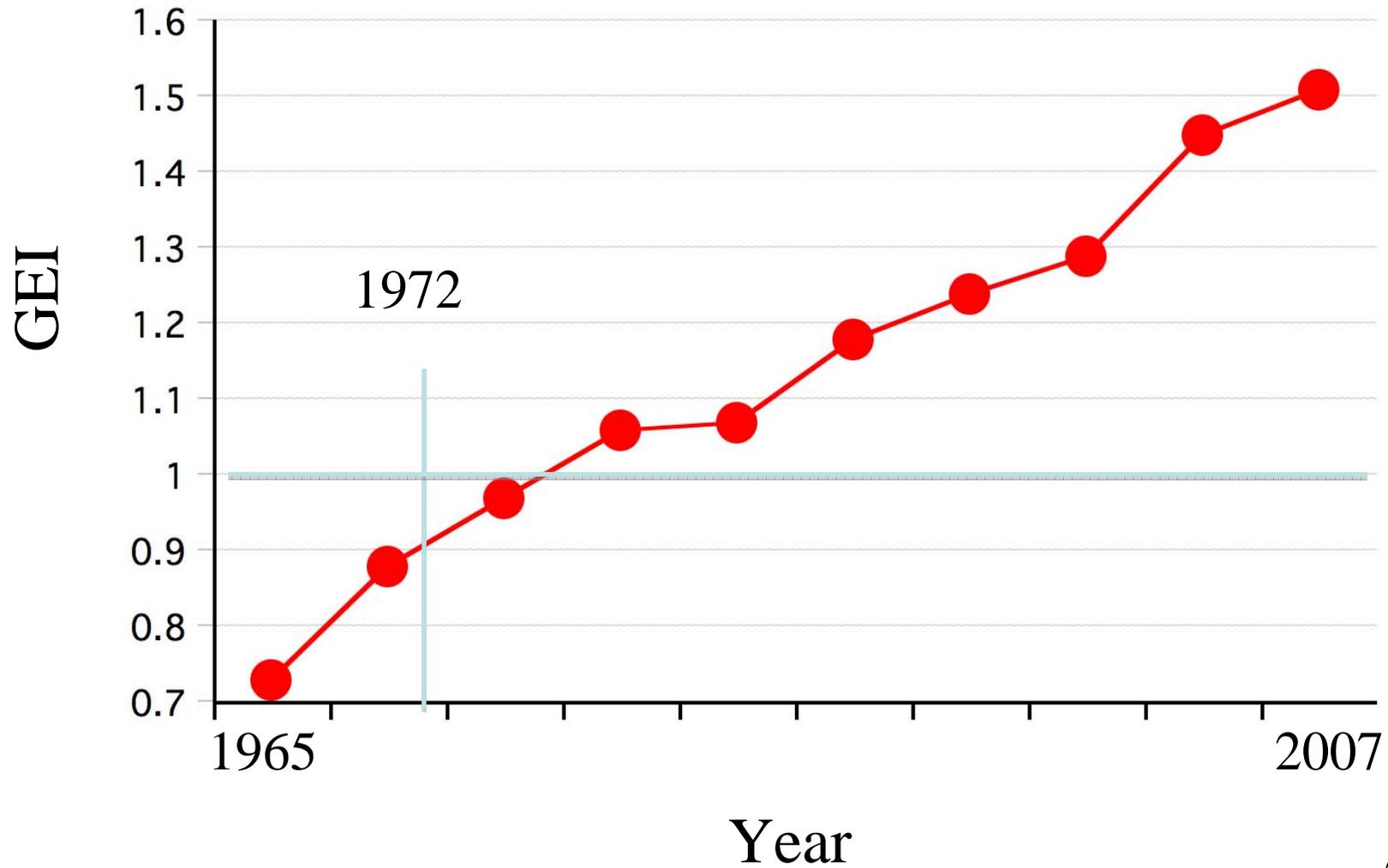
Oil Price Signals the Decline



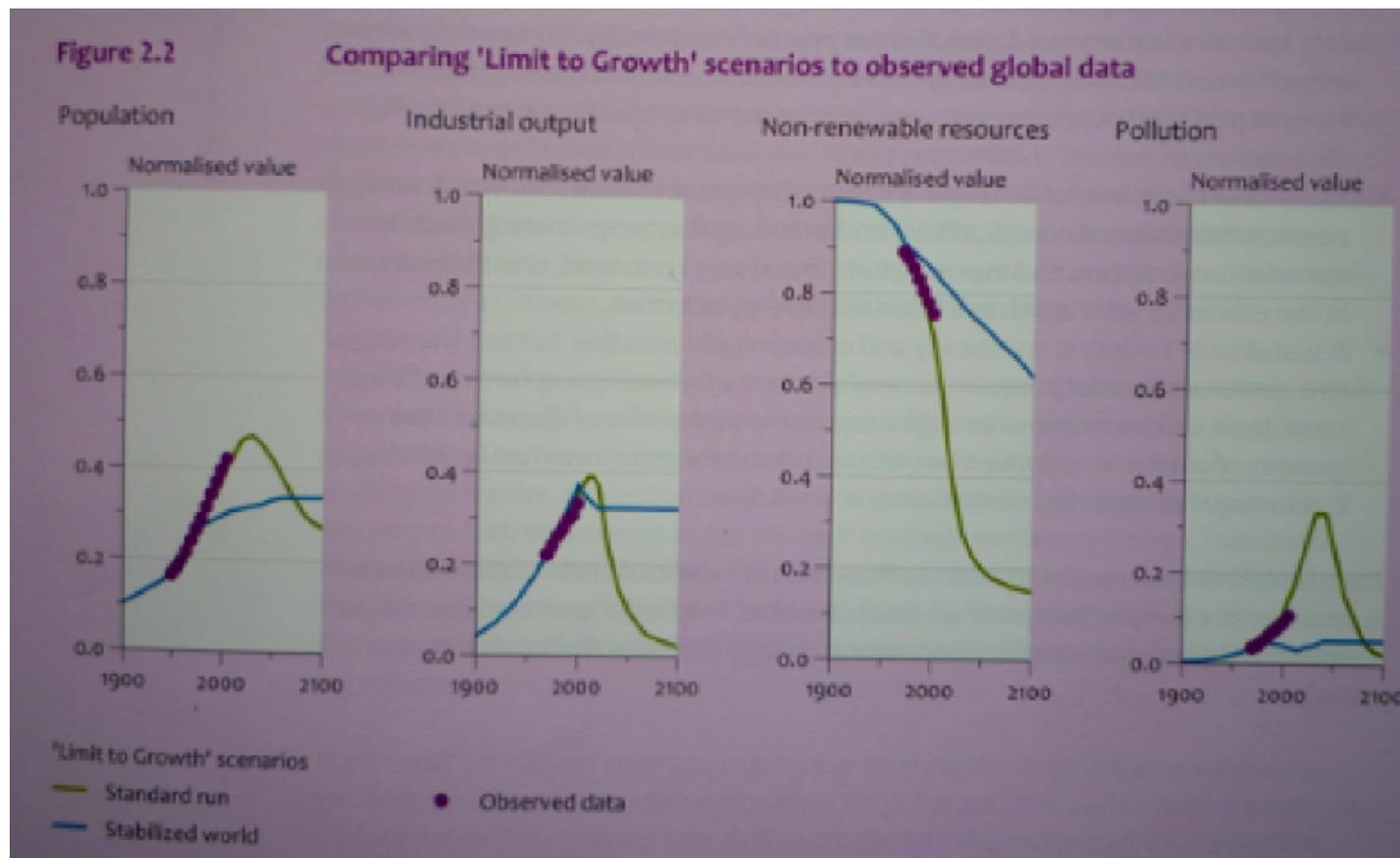
Source: Global Financial Data, GMO As of 3/31/11



Global Ecological Footprint



We are following the collapse scenario



From: *Growing within Limits*, Netherlands Environmental Assessment Agency, October 2009, page 23.

The Time of Greatest Stress

- Most people assume that the major global difficulties would occur after the end to growth.
- This is not correct.
- The globe's population would experience the most stress prior to the peak, as pressures mount high enough to neutralize the enormous political, demographic, and economic forces that now sustain growth.
- We are in the early phases of that period now; you will experience more change over the next 20 years than occurred during the past 100 years.

Number of Natural Disasters Each Year: 1900 - 2005

Data show incidence of: Flood, Windstorm, Epidemic,
Earthquake, Drought, Extreme Temperature, Slide,
Wildfire, Volcanic eruption, Famine, Insect
infestation, Wave/surge

