

# Sustainability: Energy, the Environment, and Society

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MEB415

Spring 2012

# Contents of this Lecture

1. Defining “sustainability”
2. Debate over sustainability
3. Sustainability and the Future of Energy

# 1. What is Sustainability?

- Is there an environmental crisis?
- Major stresses on the global environment include:
  - Overharvesting
  - Water and soil pollution & depletion
  - Atmospheric pollution: smog and climate change
  - Loss of biodiversity: Habitat destruction & species extinction

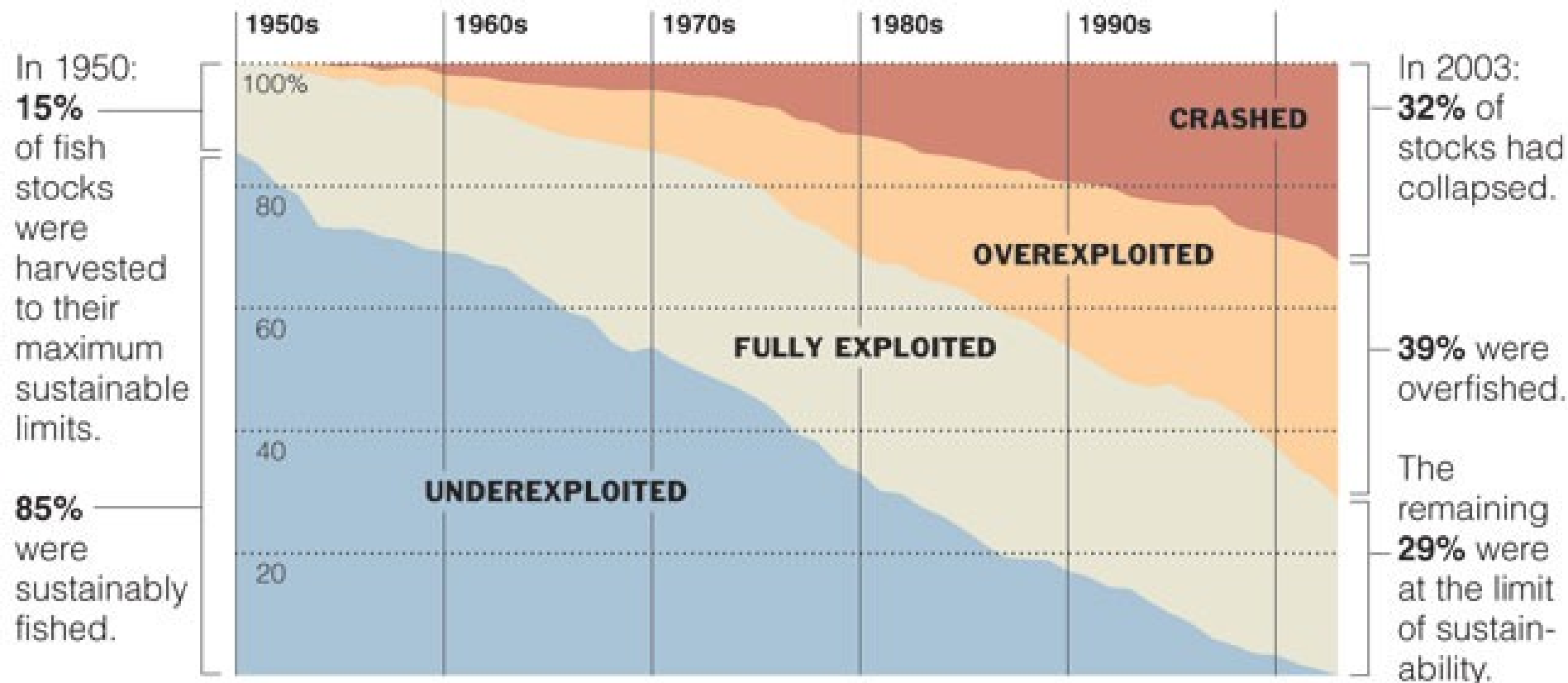
# Deforestation



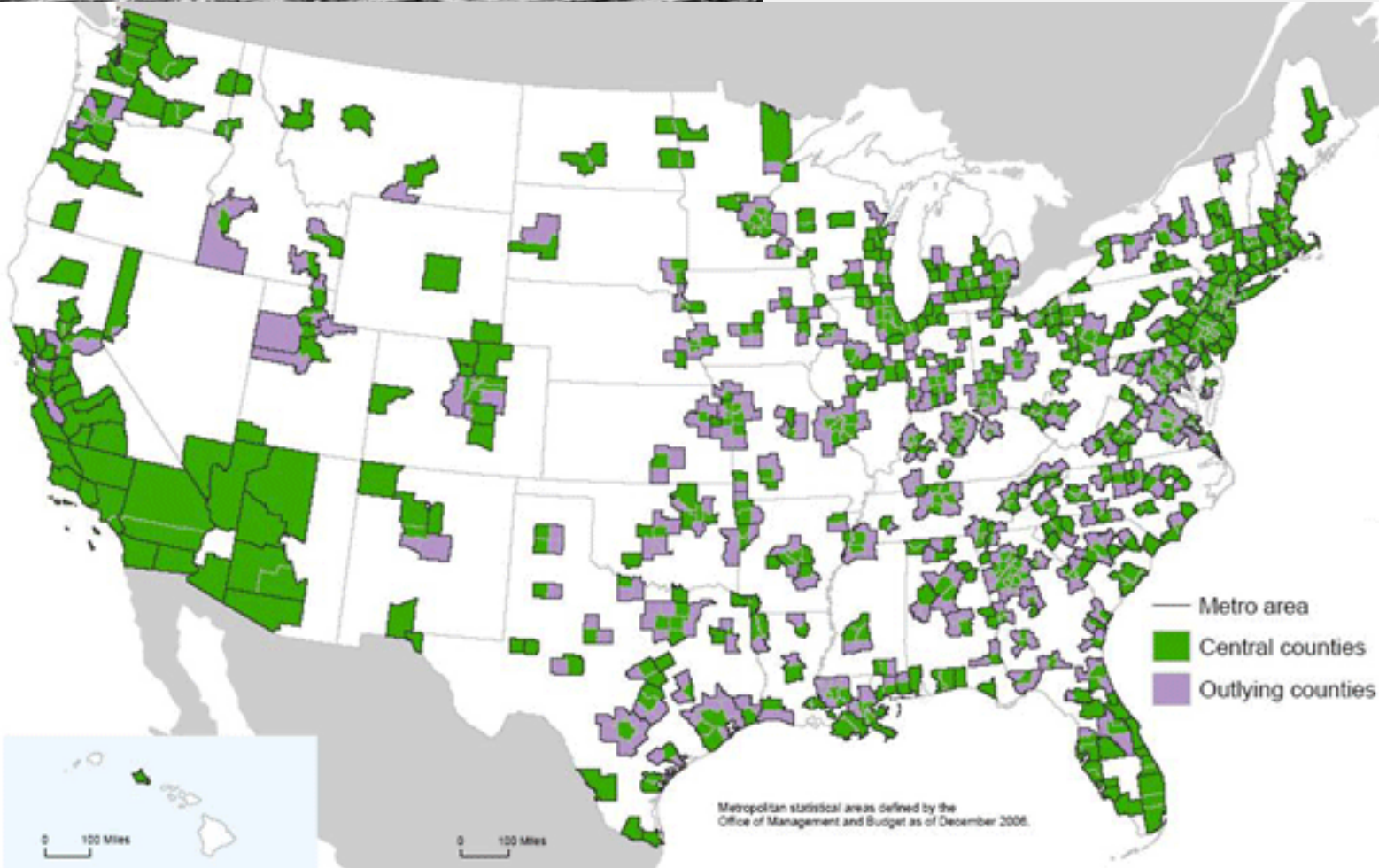
# Fisheries Collapse

## At the Breaking Point

The condition of the world's fisheries has declined drastically because of overfishing.



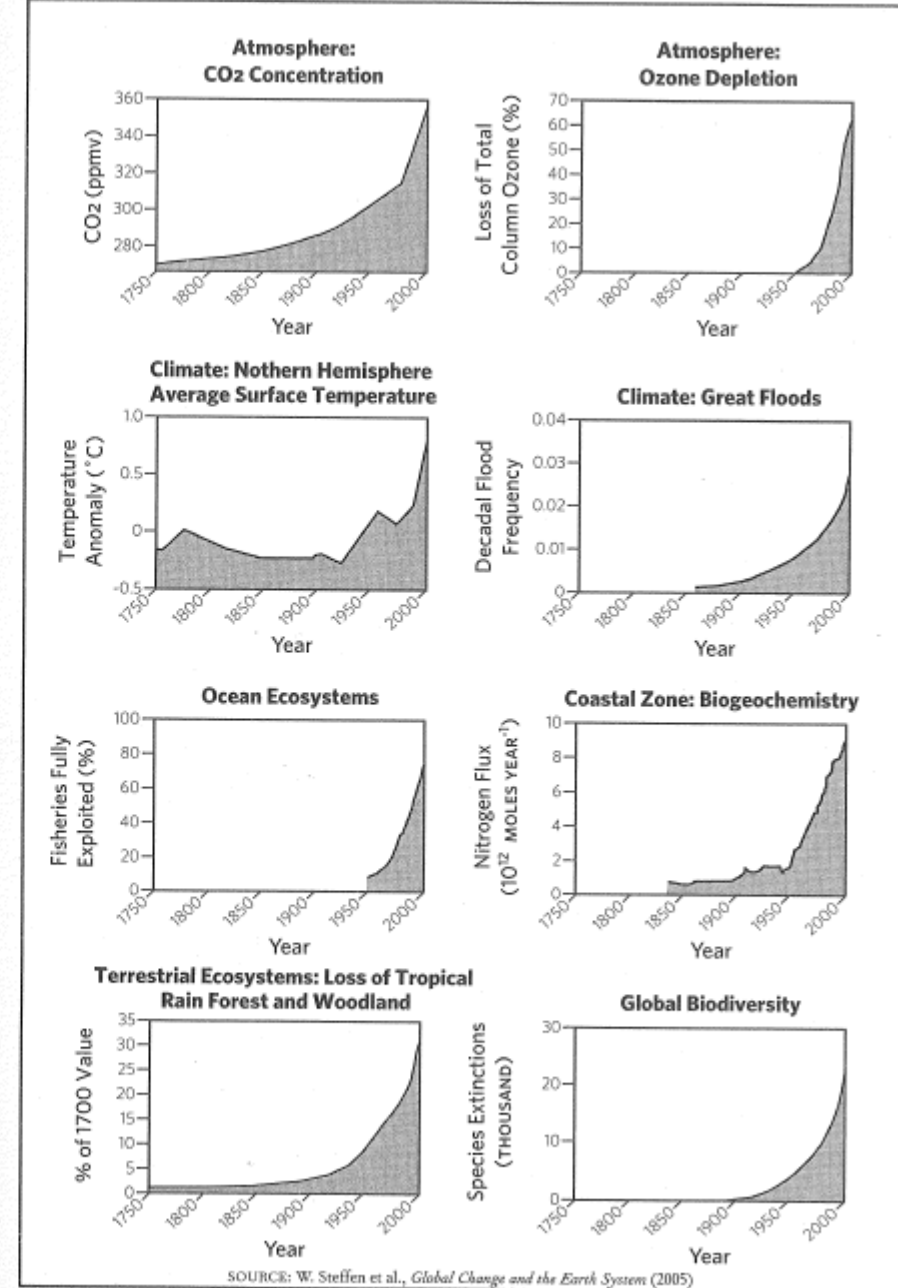
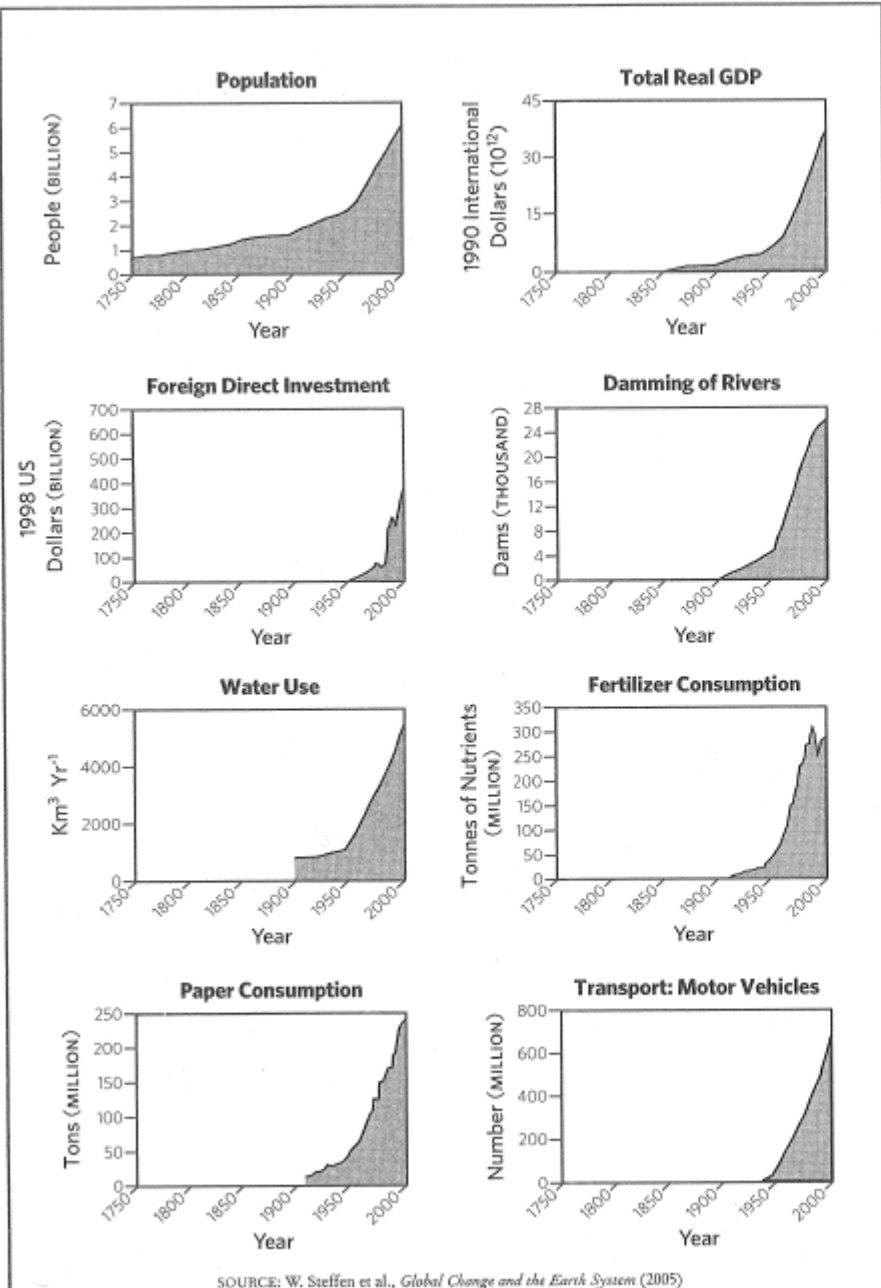
# Suburbanization / Land use



# Climate Change

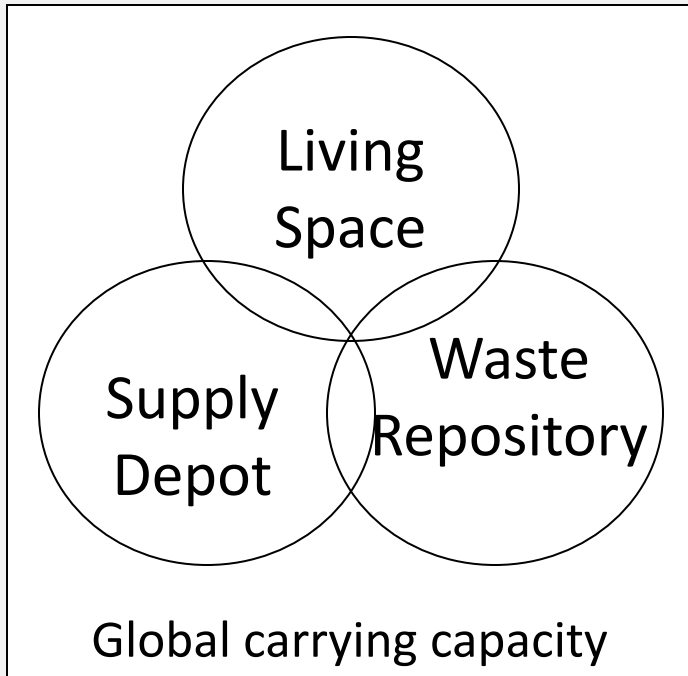


# Human Environmental Impacts 1750-2000

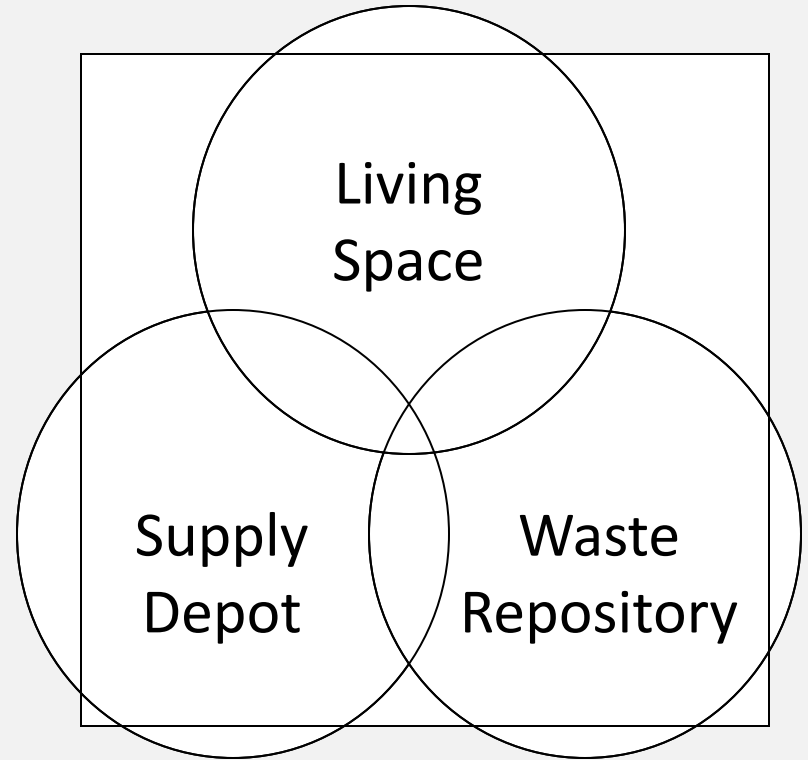




# “Overshoot”



About 1900



Today

# Definitions

Webster's dictionary:

Sustainable = “a method of harvesting or using a resource so that the resource is not depleted or permanently damaged”



# Definitions

- Brundtland, *Our Common Future*, 1987: the ability to meet our needs without compromising the ability of future generations to meet their needs.
- Three main factors: ecology, economy, society
- Intergenerational solidarity

# Definitions

Worldwatch: “Ultimately, sustainable development and sustainability itself are about collective values and related choices and are therefore a political issue....

Because values, politics, and our understanding of the Earth and its systems will evolve, notions of what is sustainable will never be static.”

# Dimensions of Sustainability

## Worldwatch article: 4 dimensions of sustainable development

1. Human survival
2. Biological diversity
3. Social equity
4. Quality of life



### What Is Sustainability, Anyway?

by Thomas Prugh and Erik Assadourian

#### Introduction

Twelve years ago this September, eight men and women said goodbye to well-wishers and walked into Biosphere II, a 3.1-acre airtight greenhouse in the Arizona desert. The door was sealed behind the "mission," a team of specialists right out of *Mission: Impossible*: a systems engineer, a physician, two biologists, agricultural scientists, a computer systems expert. They planned to remain under glass together for two years, proving that humans could design, construct, and live in a self-sufficient ecosystem.

The project got off to a good start and ran smoothly for several months. The \$200-million enterprise represented years of planning and the most up-to-date research into ecosystem design and function, and the planners seemed to have thought of everything. Like the Earth ("Biosphere I"), Biosphere II was a closed system except to sunlight. It featured a productive mix of biomes, including miniature forests, lakes, streams, and even an "ocean." The researchers expected to live off the system's internal output, without additional food, oxygen, or other supplies, throughout the experiment.

In *Mission: Impossible*, the experts routinely encounter odds that seem impossible indeed, but the operations nevertheless always go flawlessly. Biosphere II's experts, on the other hand, were blindsided by unforeseen developments. After 18 months, oxygen concentrations had dropped from 21 percent to a marginal 14 percent, the level found at about 17,500 feet. The carbon dioxide exhaled by the bacteria-rich soils was being absorbed and bound up in the concrete walls of the building, so the plants couldn't break it down into carbon and free oxygen. Other troubles, apart from friction among the human inhabitants, included the extinction of three-quarters of the small animal species and all of the pollinating insects. Insect life in general came to be dominated by ants. Food plants grew poorly, but weedy vines ran wild. (Supplemental oxygen pumped into the greenhouse kept the crew going for the full two years.)

Biosphere II was a physical experiment in sustainability. The project scraped off all the political and rhetorical barnacles that cling to the idea of sustainability, leaving the essential question: How do we make a self-contained place to live, and keep it going for a long time? The question is important because human beings are doing many things to the planet that are, or may be, destructive to the natural systems we depend on. But scaling the question up to the full-size real world brings back the barnacles and makes the matter complex and ambiguous, because of the many "it depends" questions that must be asked: For how long? For how many people? Are they rich or poor? What are their views of other creatures? What technologies are available? and so on.

Despite its limits, the answer that came out of Biosphere II is valuable. Since it was just an experiment, it would be inaccurate to say it failed; it simply yielded data. One of the things it showed is that ecosystems are

16 WORLDWATCH September/October 2003

# Human Survival

- The survival of *Homo sapiens* as a species is not threatened
- But risks do threaten individuals, and whole populations



# Biological Diversity

Values of biodiversity:

- Biocentric
  - Ecosystem stability & health
  - Deep ecology: intrinsic value of nature
- Anthropocentric
  - Utilitarian – use by humans
  - Example: food security



# Social Equity

- Environmental problems result from social problems – and cause social problems
- Today income inequality is growing – between Global North & South, and within nations





# Social Equity

Redefine “national security” to include global environmental and economic justice, not simply military protection



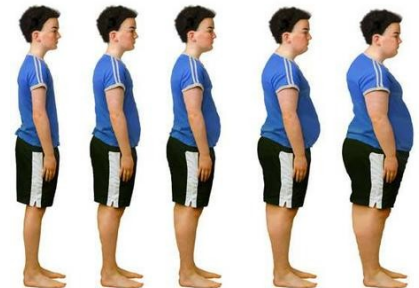
# Quality of Life

- There is more to life than material standard of living
- GDP cannot measure the true level of material well-being



# Quality of Life

- Overconsumption has become a problem in many developed nations
- Lifestyle diseases: obesity, diabetes
- Economists: The hedonic treadmill may not make us happy



# Prescriptions for Sustainable Development

For global sustainability, the economy must harmonize with the earth's natural systems

- Seek new energy sources
- Protect habitat
- Control consumption
- Control human population
- Apply the Precautionary Principle



# Precautionary Principle

Wingspread conference (1998):

“When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically.”

# Precautionary Principle

- If a technique or technology could be harmful, limit it or do not use it
- Prugh & Assadourian: Adopt PP because of the high uncertainty of our understanding of ecosystems and the impacts, for example, of many chemicals



# 2. Is Sustainability Possible?

- Debate
- Spectrum of opinions
  - Cornucopians
  - Reformists
  - Revolutionaries
  - Environmental determinists



# Perspectives on Sustainability

Cornucopians

Reformists

Revolutionaries

Environmental determinists





# Debates About Sustainability

- Cornucopians: “Sustainability” is nothing to worry about
- Reformists: Work within existing structures to make society more “green”
- Revolutionaries: Sustainability is not possible without radical change
- Environmental determinists: Ecological limits will impose changes on society whether we like it or not

# Critique of “Sustainability”

- Vague concept
- Wide range of opinions
- Cornucopians: it's not necessary to restrict growth
- Others say growth is inherently unsustainable

# Cornucopians

- There are plenty of natural resources
- Prices for many basic industrial inputs have declined
- Human intelligence is the “ultimate resource”
- More people is good
- We can create new technologies



Julian Simon  
1932-1998

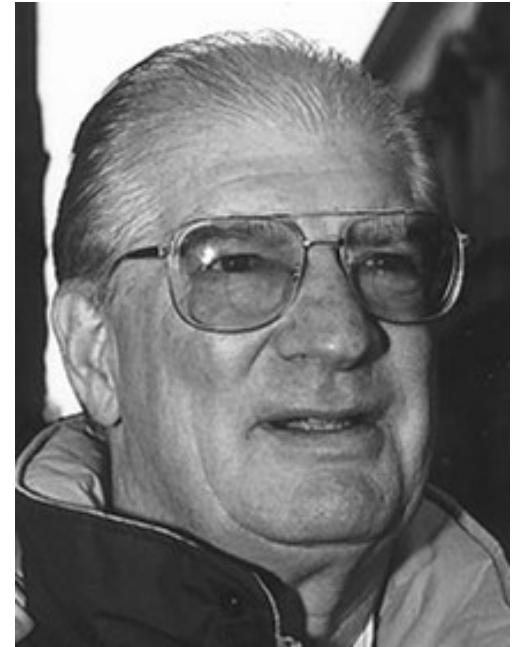
# Response to the Cornucopians

## The Logic of Limits to Growth

- For physical reasons, there is a limit to the amount of resources on earth and the number of people that can live on earth ...
  - ...Thus, economic growth cannot be infinite.
- The current economic system is based on the assumption that growth is desirable and infinite
  - ...Thus, the present economic system is unsustainable.

# Daly: Sustainable Development vs. “Sustainable Growth”

- Sustainable development = economic improvement without growth
- Growth vs. development: “When something grows it gets bigger. When something develops it gets different.”



Herman Daly

# Daly and Development

A sustainable economy: Stops increasing raw natural resource inputs, and at some point settles at a scale at which the environment can continue to function and renew itself naturally. This “non-growing” economy is always changing and adapting – not stagnant.

# 3. Sustainability and the Future of Energy

- The problem: “peak oil”
- Solutions/responses?



# Peak Oil

- Hubbert's peak theory
- Does not mean all oil is gone
- Half-way point means no greater amount of oil can ever be produced

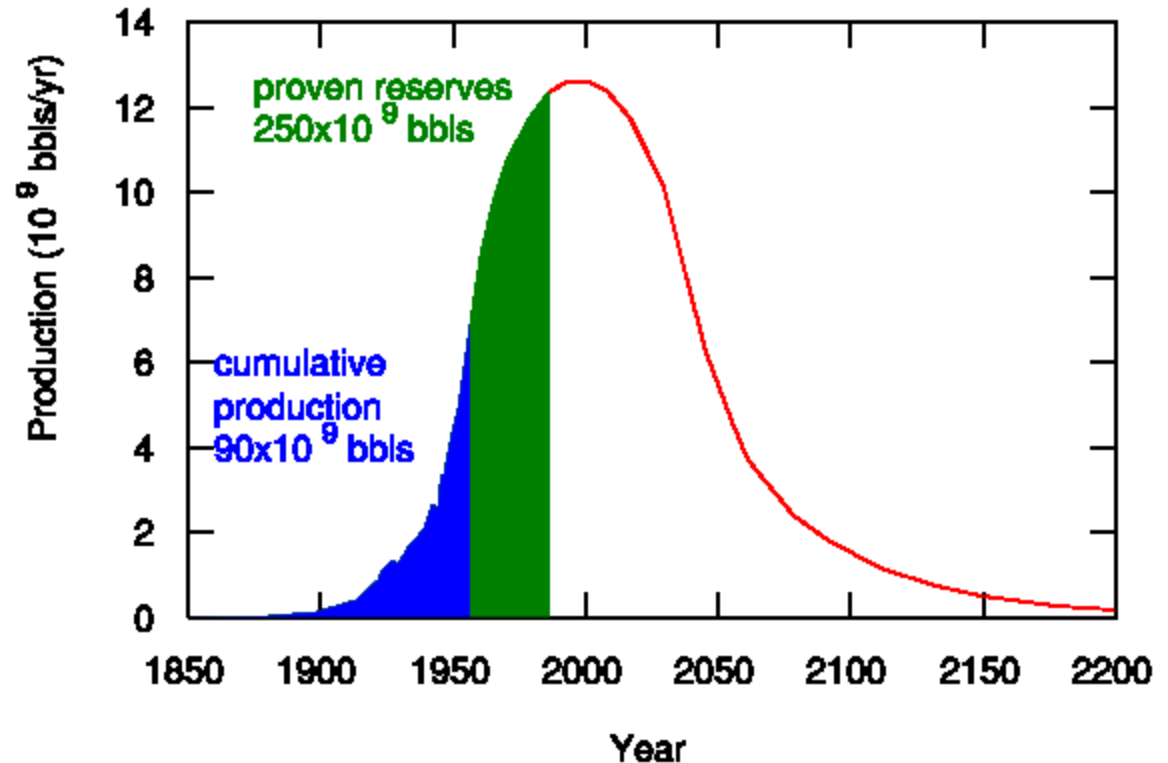
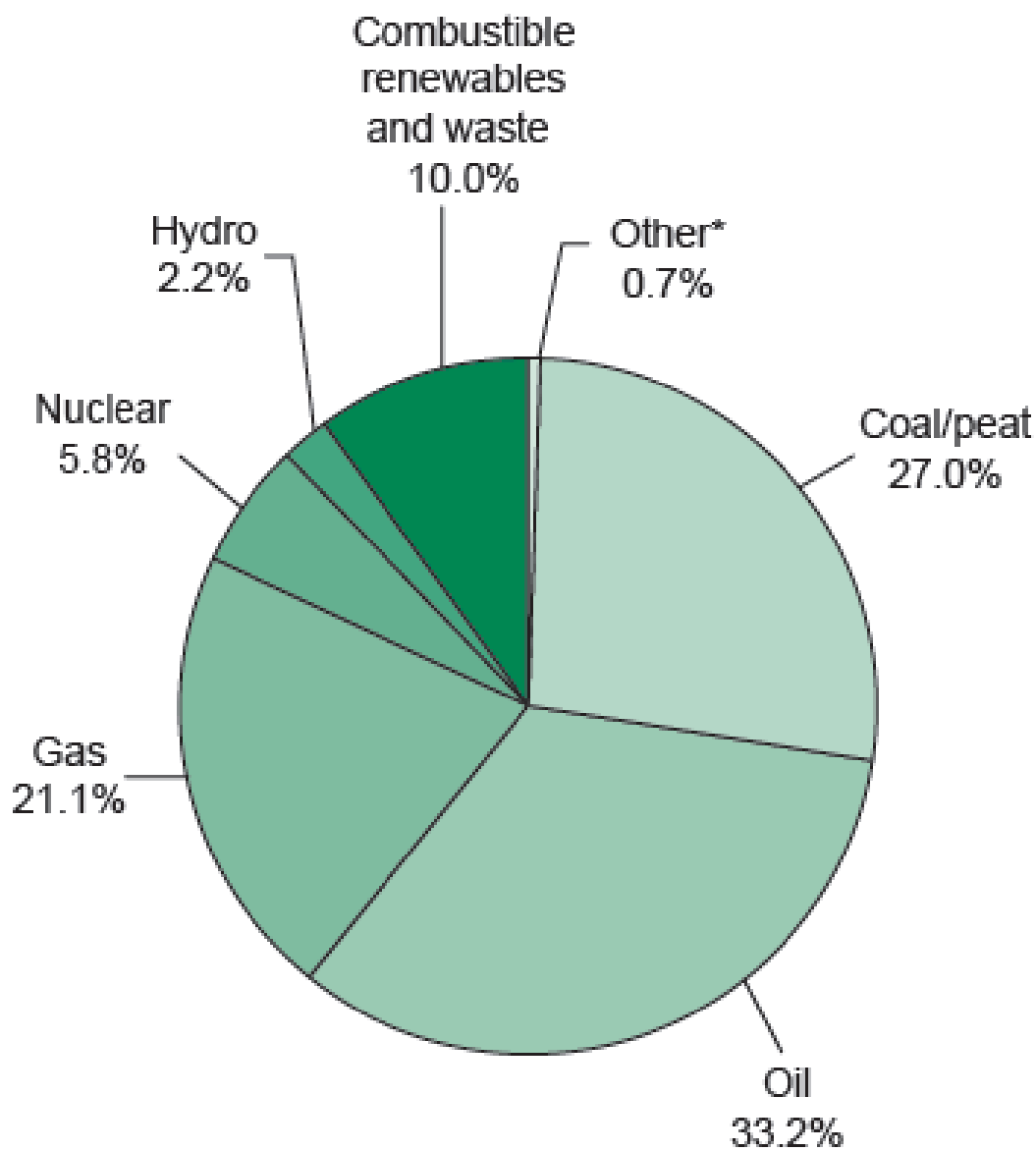




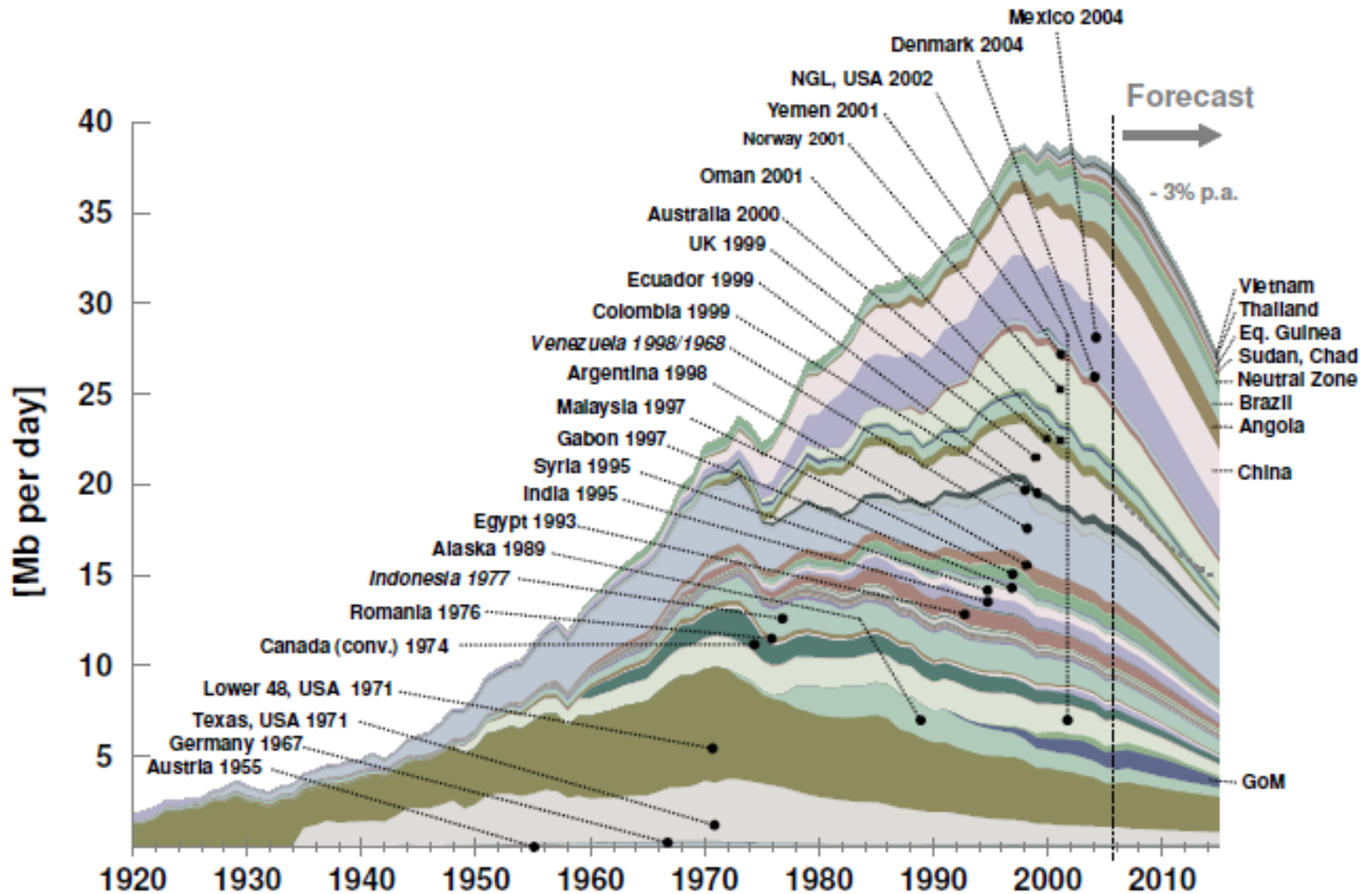
Figure 1.2 Share of total world primary energy supply by type of fuel in 2008.



# Peak Oil

- USA peaked in 1970
- Practically all major producers have peaked, such as Russia, Mexico, Kuwait, North Sea, Venezuela, Norway, and perhaps Saudi Arabia
- As a group, all oil-producing countries outside OPEC and the former Soviet Union peaked around 2000
- OECD's International Energy Agency: Global conventional crude peak was in 2006

# The Past

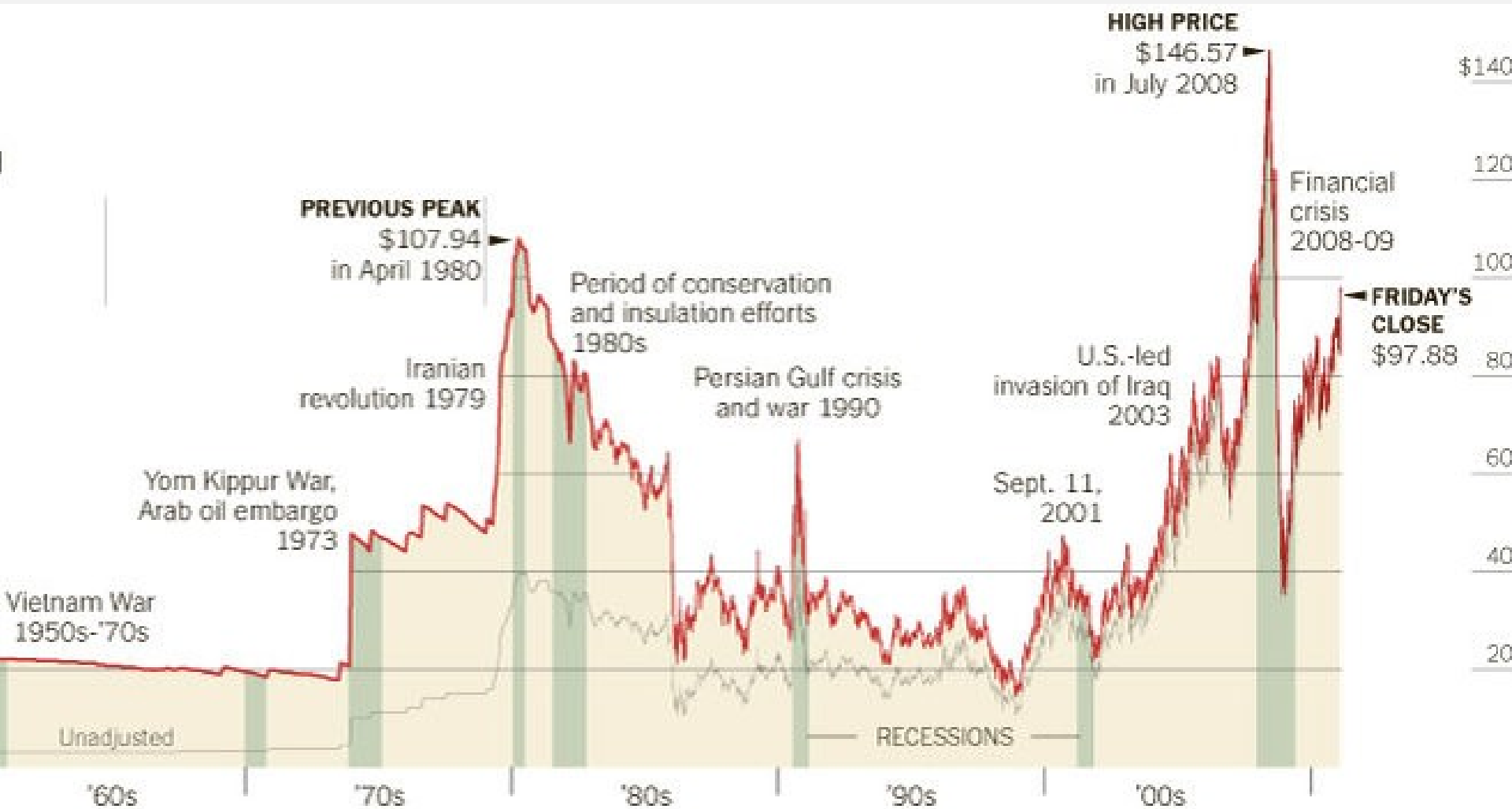


# A Looming Energy Crisis?

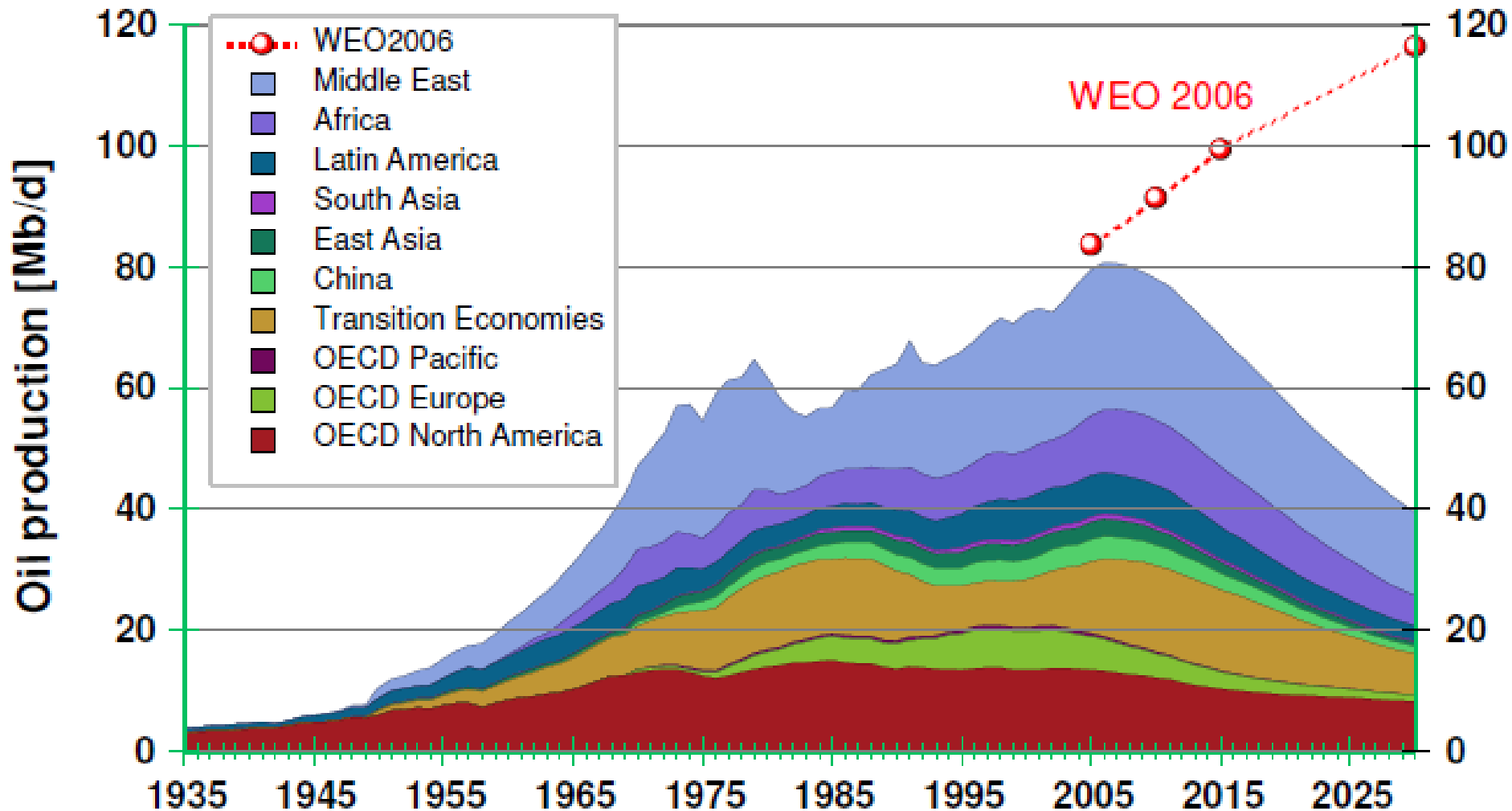
Data from February 2012

- US petrol prices now at record highs
- Former Shell Oil CEO:
  - \$5/gallon this summer, up to \$7-8 and rationing in 2015
  - India demand: from 4 to 7 mbd in 2015
  - China demand: from 9 to 15 mbd in 2015
- Czech coal reserves expected to run out in 2030

# Historic Oil Prices



# The Future



# Economic and Social Impacts

- Oil will be more difficult & expensive to get
- Declining oil quantity
- Conflict over remaining energy resources?



# Alternatives to Crude Oil

- Natural gas
- Coal
- Tar sands
- Shale Oils
- Ethanol, biofuels
- Methane hydrates
- Nuclear fission
- Hydrogen
- Wind
- Solar
- Water power





# The Debate over Nuclear Power

Kunstler: No combination of energy alternatives can replace oil

Environmentalists like George Monbiot and James Lovelock advocate increased use of nuclear power



# “The Long Emergency”

Modern society faces a convergence of problems:

- Energy scarcity
  - IEA: crude production will be on an “undulating plateau”
- Climate change
  - Food scarcity
  - Disease
  - Natural disasters
- Geopolitical instability
- Economic instability



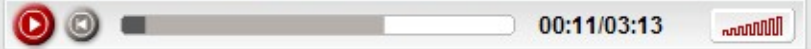
James Kunstler

# Sustainable Solutions?

- Mainstream capitalists & politicians: new technologies
- Deep ecologists: new values & lifestyle
- Kunstler: no solution is in sight; We will keep doing what we're doing until we can't any more
- McKibben: pro-active localization

# McKibben and Localization

- Local production
- Alternative agriculture
- Urban farming
- Reduced use of automobiles



# Localization

- Revitalize communities:
  - Culture
  - Politics
  - Economic relations
- Example: Community gardens and Community Supported Agriculture (CSA)
  - Reduce greenhouse emissions
  - Reduce use of fossil fuels
  - Improve nutrition



# Conclusion

- There is strong evidence that humans are having a negative global environmental impact
- The question is: What action can we take to balance the needs of society and the needs of nature?
- Science can give us data about the situation, but finding solutions will be a political process