Our Ecological Footprint:
Marching Toward the Abyss?

William E. Rees, PhD, FRSC
UBC/SCARP

PROBUS Club North Shore (Vancouver)
10 August 2015

Problem Context:
Excessive Scale of the Human Enterprise

Ours is a world in ecological 'overshoot':

- GHGs are accumulating
- climate is changing
- the oceans are acidifying
- fresh waters are toxifying
- the seas are over-fished
- soils are eroding
- deserts are expanding
- tropical forests are shrinking
- biodiversity is plummeting (etc., etc.)

Bottom line:

The human enterprise already exceeds the long-term carrying capacity of Earth; production, consumption and waste generation exceed the regenerative and assimilative capacities of the ecosphere.

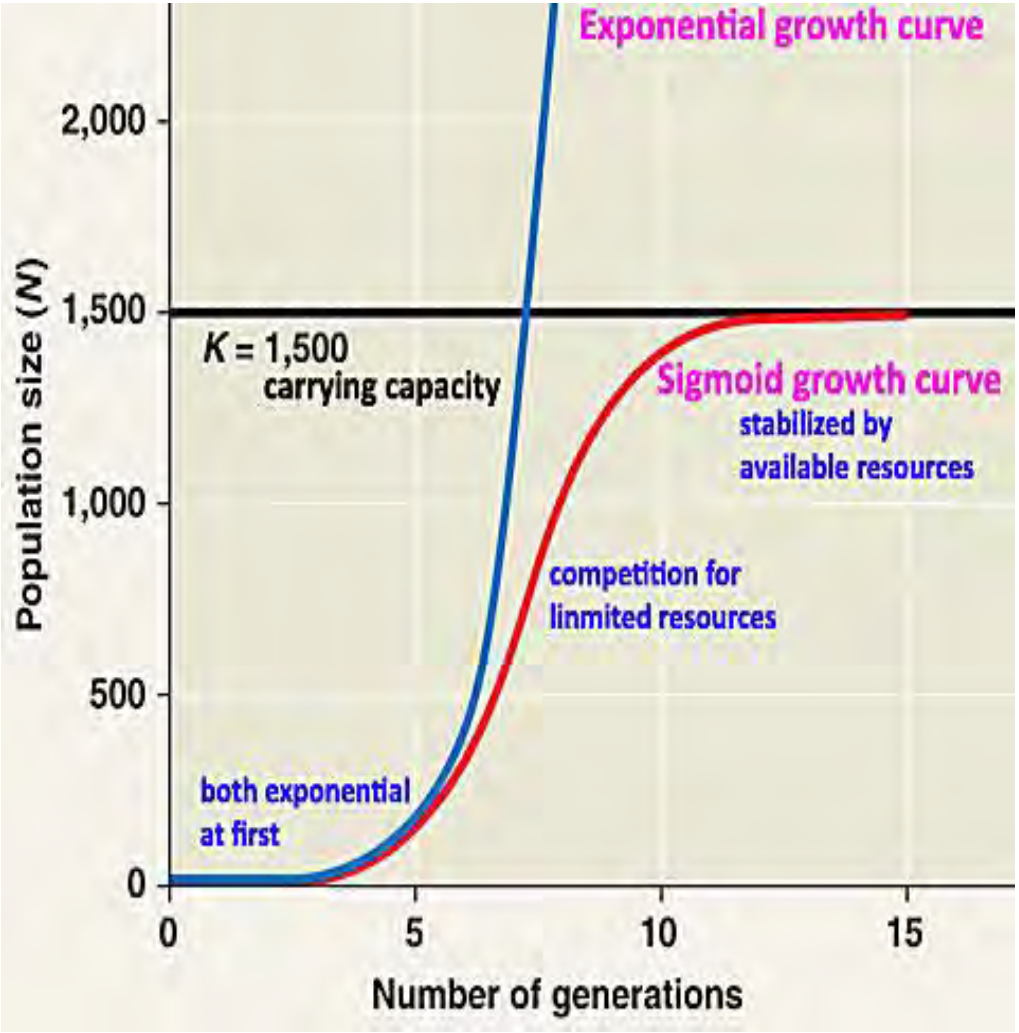
Hypothesis: *H.Sapiens* is inherently unsustainable

Factor 1:

Base nature (genetic predisposition)

- Unless or until constrained by negative feedback, *H. sapiens*, like all other species/populations tend to:
  - ***expand to fill all accessible habitat***
  - ***use all available resources (in the case of humans "availability" is constantly being redefined by technology)*** (Rees 2006).

Humans: Archetypal ‘K’-strategists



- **Typical ‘K’-Strategist** Large, long-lived, slowly reproducing, competitive organisms that usually express intensive parental care and high survival rates to maturity.
- Local populations tend to press up against carrying capacity.
- Humans are clearly ‘K-strategists, a distinction we share with other mammals ranging from tapirs through elephants to blue whales.

Factor 2:

Careless nurture (cultural predisposition)

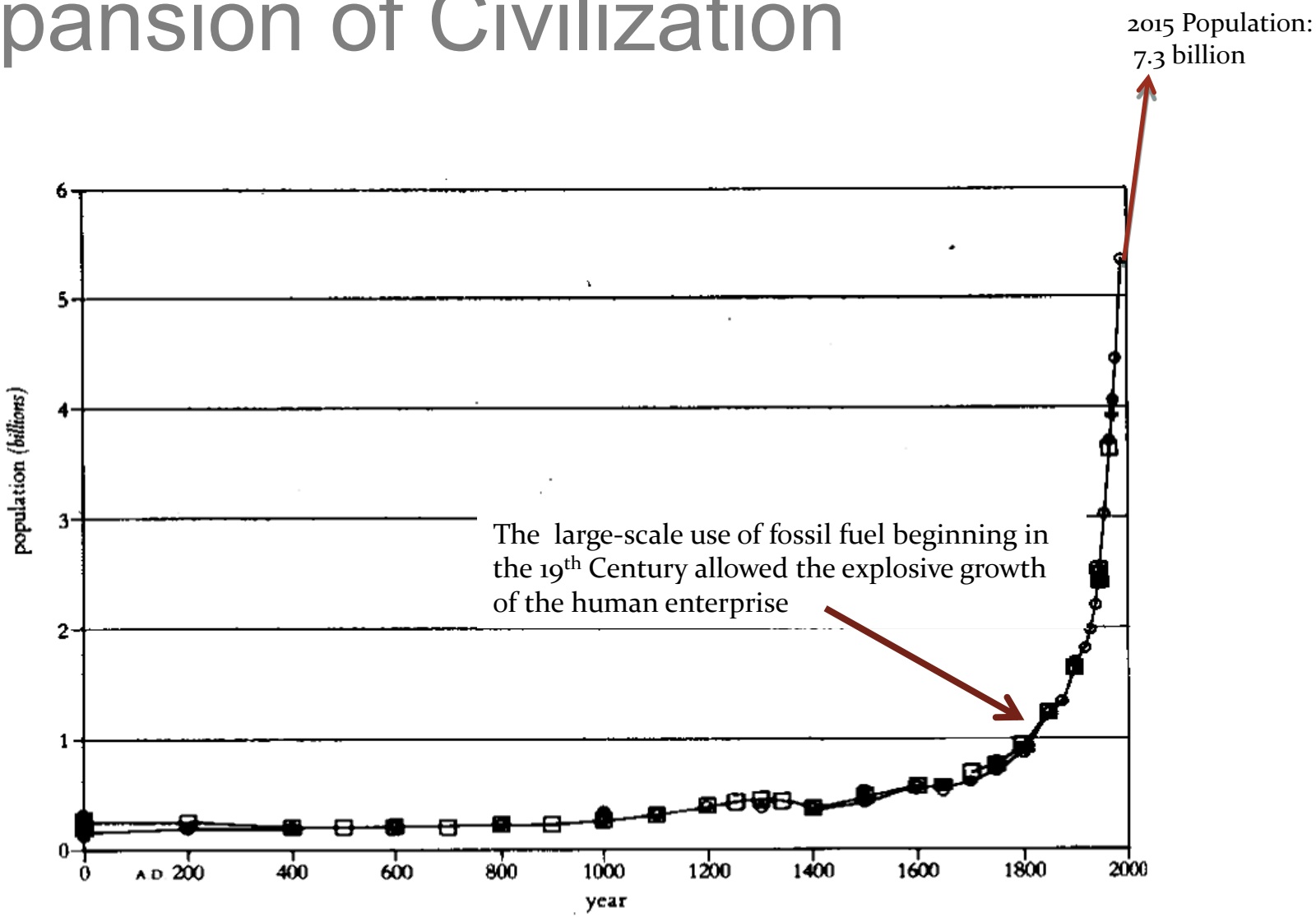
- Our socially-constructed myth of progress and continuous growth:

  "We have in our hands now… the technology to feed, clothe, and supply energy to an ever-growing population for the next seven billion years…" (J. Simon 1995).

- The emergence of a socially-constructed new 'age of unreason'

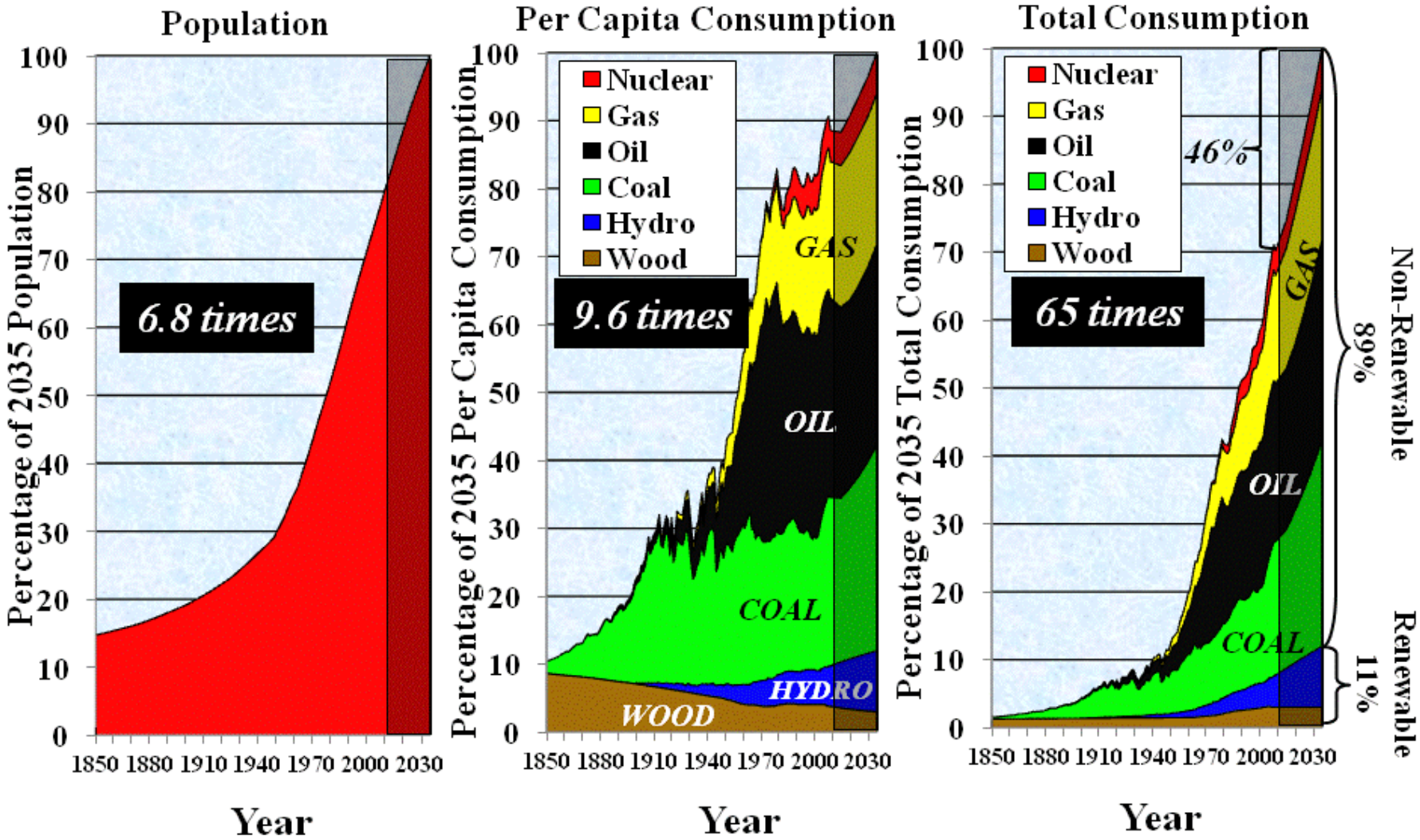
  E.g., politics increasingly influenced by neoliberal ideology, religious fundamentalism, climate-change denial, anti-intellectualism and other forms of 'magical thinking'.

Result: The Anomalous, Oil-Based Expansion of Civilization



Continuous growth—population and economic—is an anomaly. The growth spurt that recent generations take to be normal is the single most abnormal period of human history.

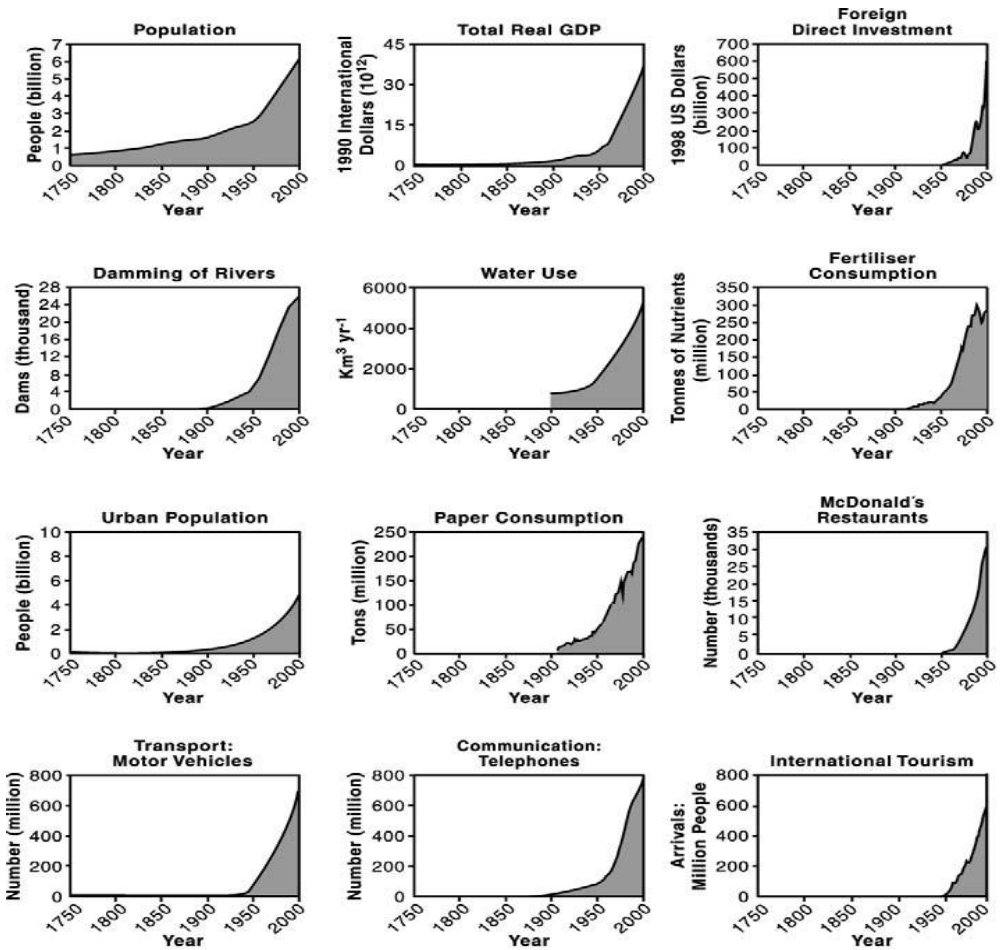
World Population, Per Capita and Primary Energy Consumption, 1850-2035, as a Percentage of 2035 Levels



(data from Arnulf Grubler, 1998; BP Statistical Review of World Energy, 2010; U.S. Bureau of Census, 2010); EIA IEO, Reference Case, 2010)

The ‘Great Acceleration’

The exponential growth of production/consumption on a finite planet



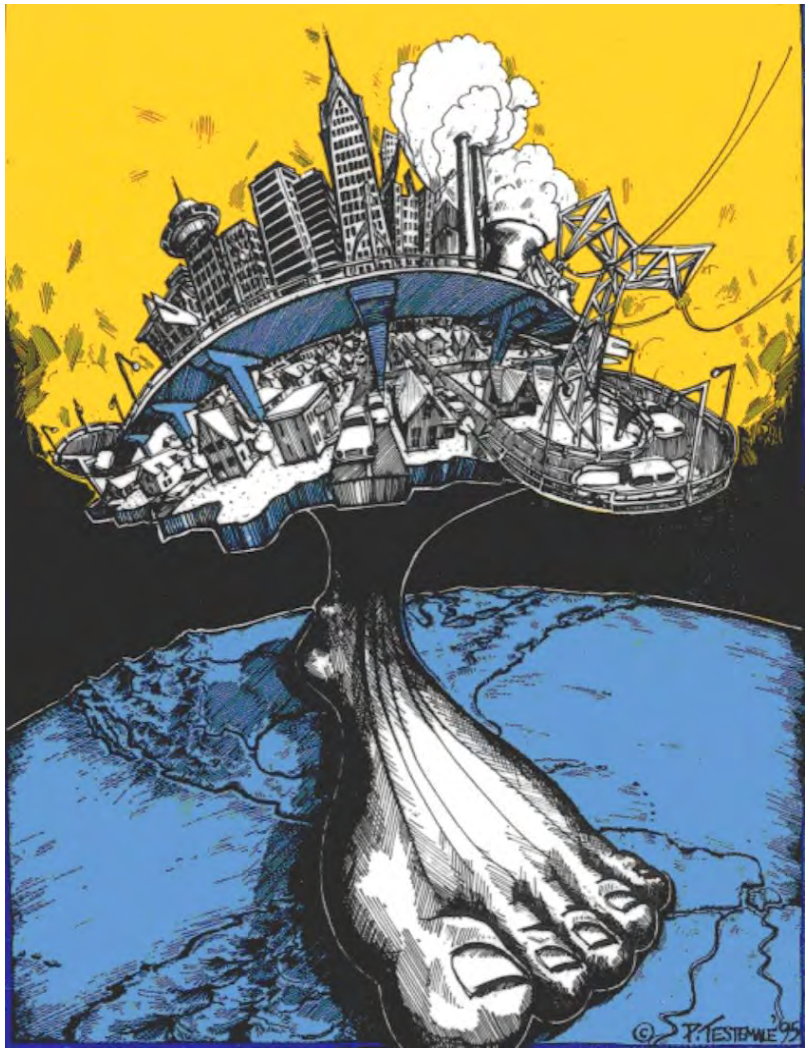
Source: Steffen, Crutzen & McNeill 2007 [Ambio 36: 314-321]

- Note that this explosion of energy and material throughput (consumption and pollution) has occurred during a period of unprecedented increases in technological and economic efficiency.
- Efficiency is not sufficient for sustainability.

Measuring 'Overshoot': The Human Ecological Footprint

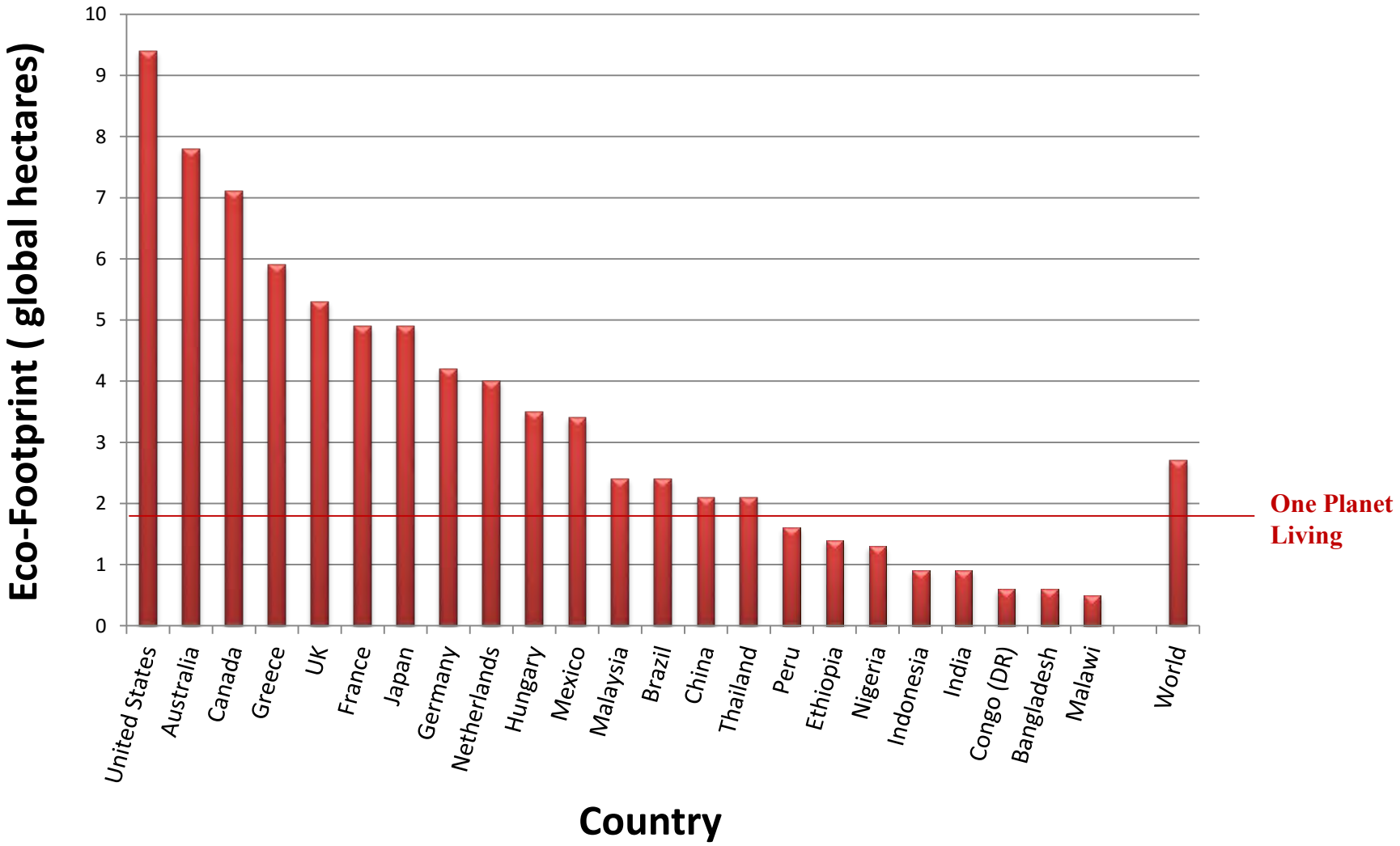
- The 'ecological footprint' of a specified population is ***the area of land and water ecosystems required*, on a continuous basis*, to produce the bio-resources that the population consumes, and to assimilate the (mostly carbon) wastes that the population produces, wherever on Earth the relevant land/water may be located and whatever the population's state of technological development***.
- NB: Eco-footprints are exclusive areas—*people compete for Earth's limited bio-capacity*.

Eco-Footprints Vary with Income

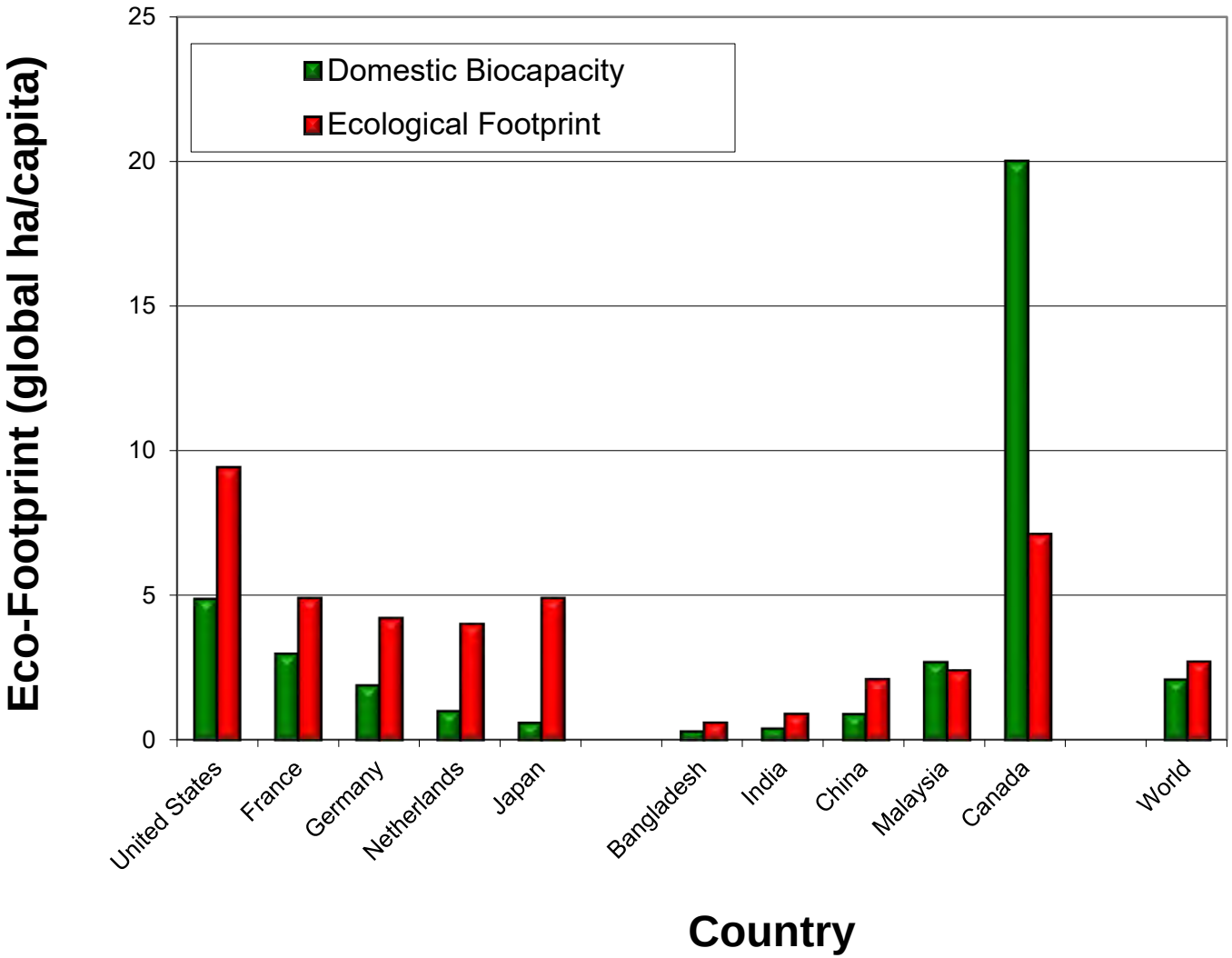


- Average per capita EFs in high-income countries range between four and ten global average hectares (10 to 25 acres).
- The poorest people live on a third of a gha (.74 ac).
- There are only about 1.7 gha per person on earth.
- North Americans use 3-4 times their equitable share of global biocapacity.

Per Capita Ecological Footprints of Selected Countries



Biocapacities and Ecological Footprints of Selected Countries Compared to the World Averages

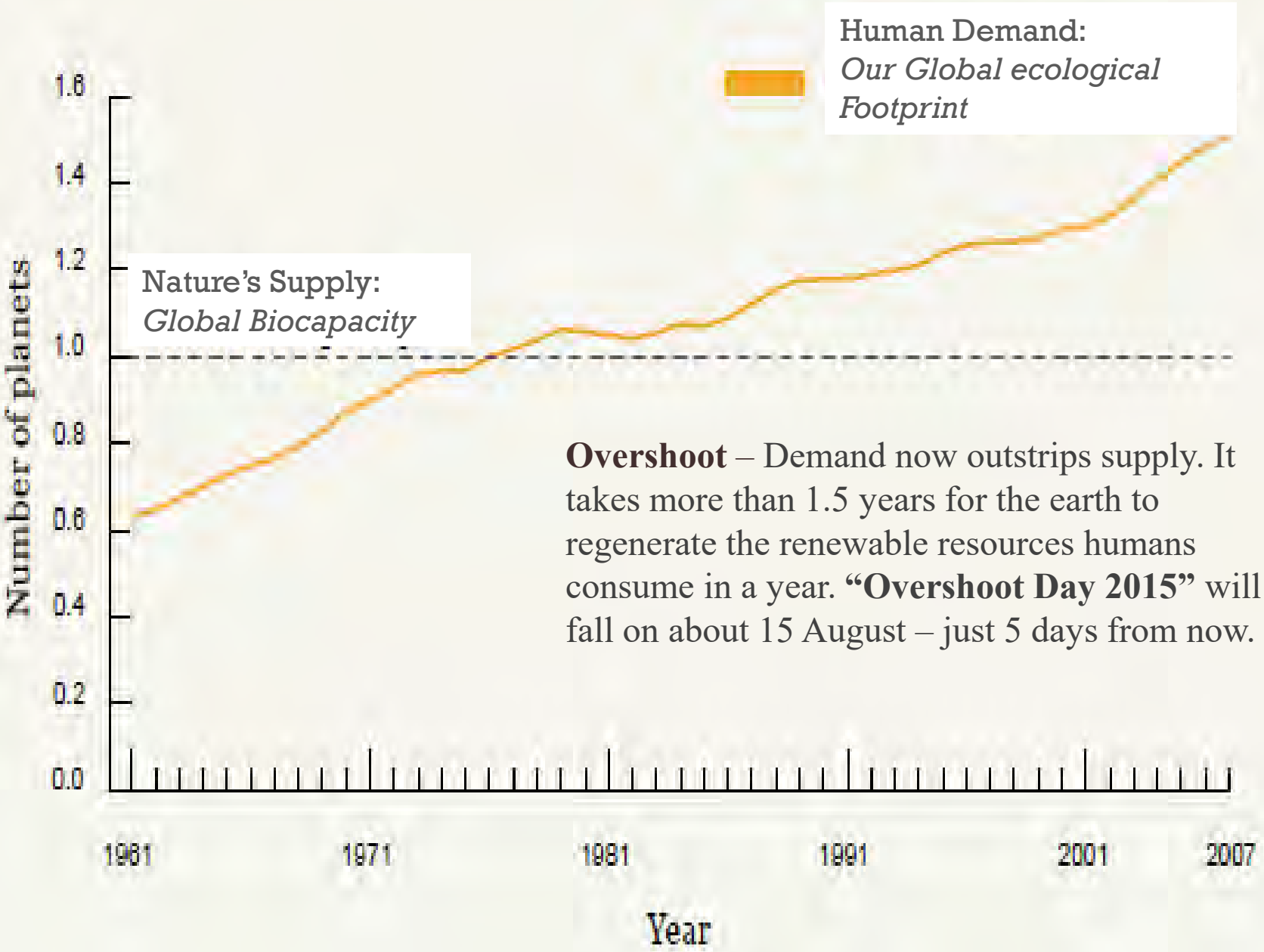


All countries that run eco-deficits are dependent on 'surplus' biocapacity (exergy) imported from low density countries (like Canada) and the global commons.

The Global Picture

global biocapacity:
12.0 billion hectares

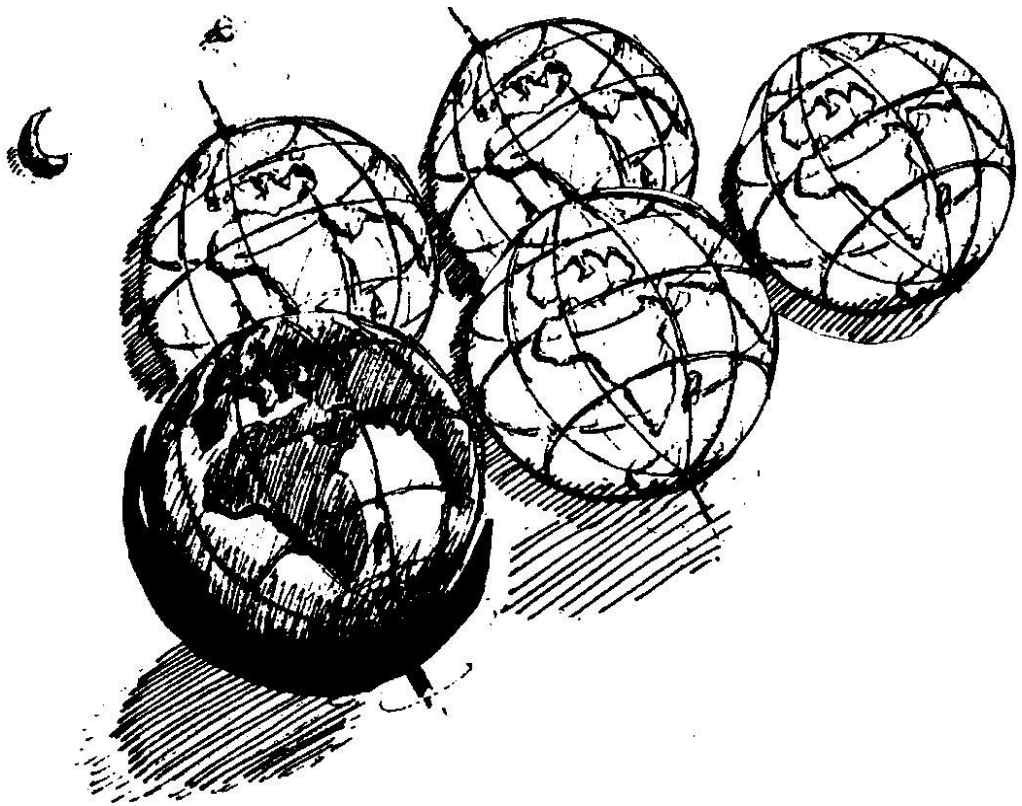
current human eco-footprint:
19.0 billion hectares



Overshoot – Demand now outstrips supply. It takes more than 1.5 years for the earth to regenerate the renewable resources humans consume in a year. **"Overshoot Day 2015"** will fall on about 15 August – just 5 days from now.

Missing: Four Phantom Planets

If everyone on Earth lived the consumer lifestyles of North Americans, we'd need three or four additional Earth-like planets.



Problem: "Good planets are hard to find."

In theory, *H. Sapiens* has unique potential to escape our predicament

- Unparalleled capacity for evidence-based reasoning and logical analysis;
- Unique ability to plan ahead;
- The capacity to exercise moral judgment;
- Compassion for other individuals and other species;
- Unique diversity of mechanisms for cooperative engagement.

The sustainability challenge: We need a new 'cultural narrative'

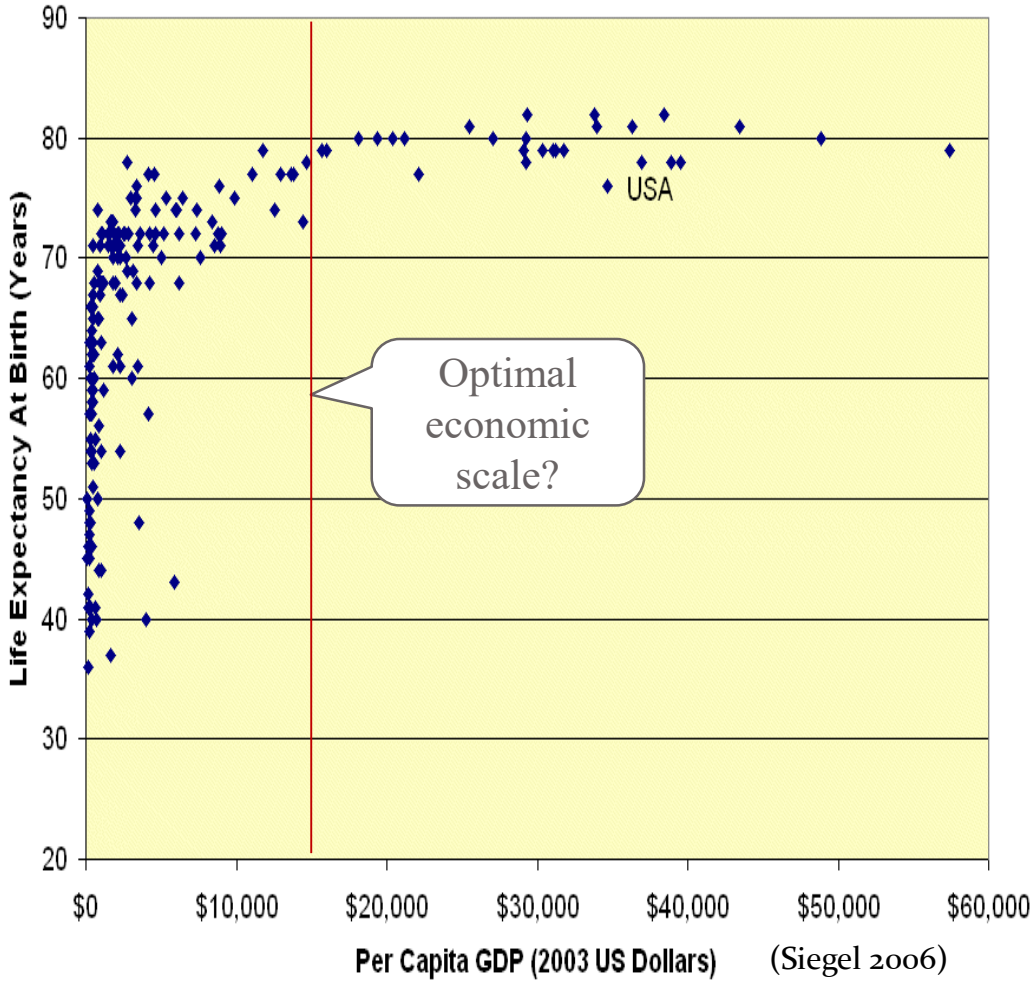
- A just sustainability requires that we live more equitably within the means of nature.
- The economic policy emphasis must shift from efficiency and growth (merely getting bigger) toward equity and development (qualitative improvement, getting better).
- The underpinning values of society must shift from competitive individualism, greed, and narrow self-interest, toward community, cooperation, and humanity's collective interest in survival.
- Motivation? For the first time, individual and national self-interests have converged with humanity's collective interests.

The material goals: Reduced throughput and greater social equity

- "Industrialized world reductions in material consumption, energy use, and environmental degradation of over 90% will be required by 2040 to meet the needs of a growing world population fairly within the planet's ecological means" (BCSD 1993) .
- To avoid a mean global temperature increase above even two C degrees, the world must reduce carbon emissions by 90% by 2050 (Tyndall Centre for Climate Change Research 2006) .
- For sustainability with equity, wealthy OECD nations should be taking steps to reduce their ecological footprints by 50% to 80% (Rees 2006).

A convenient truth

GDP Growth in rich countries no longer contributes to well-being (see ***The Spirit Level*** by R. Wilkinson and K. Pickett)

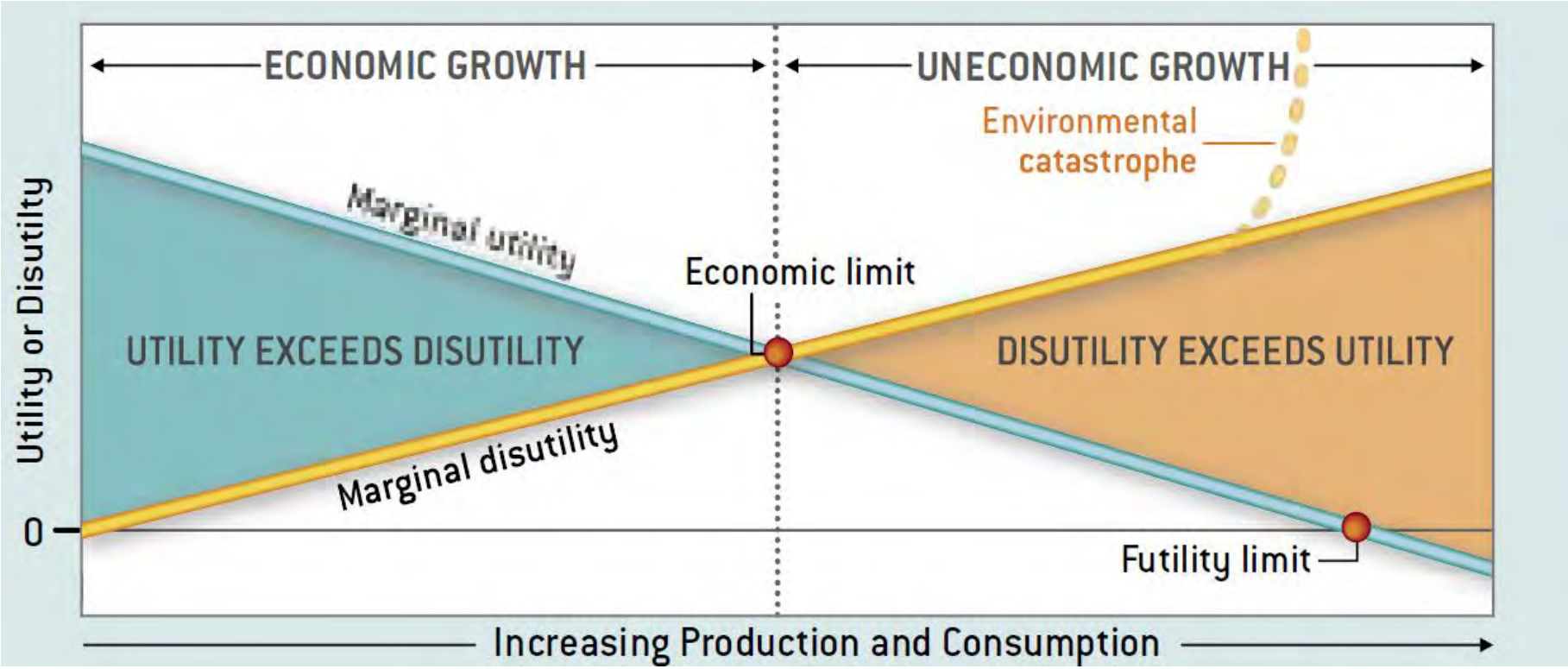


(Siegel 2006)

- Between 1976 and 2006, the Canadian economy grew by 130%; GDP per capita by 70%.
- There was no change in the percentage of the population in poverty or in the unemployment rate.
- The absolute numbers of impoverished and unemployed increased.
- Subjective well-being? Constant or declining

(Source: Victor 2008)

When growth is uneconomic



Adapted from Daly (2005)

Growth becomes 'uneconomic' when the damage costs (disutility) at the margin exceed the economic benefits (utility). Further growth makes us poorer rather than richer.

Toward a Sustainable Steady-State

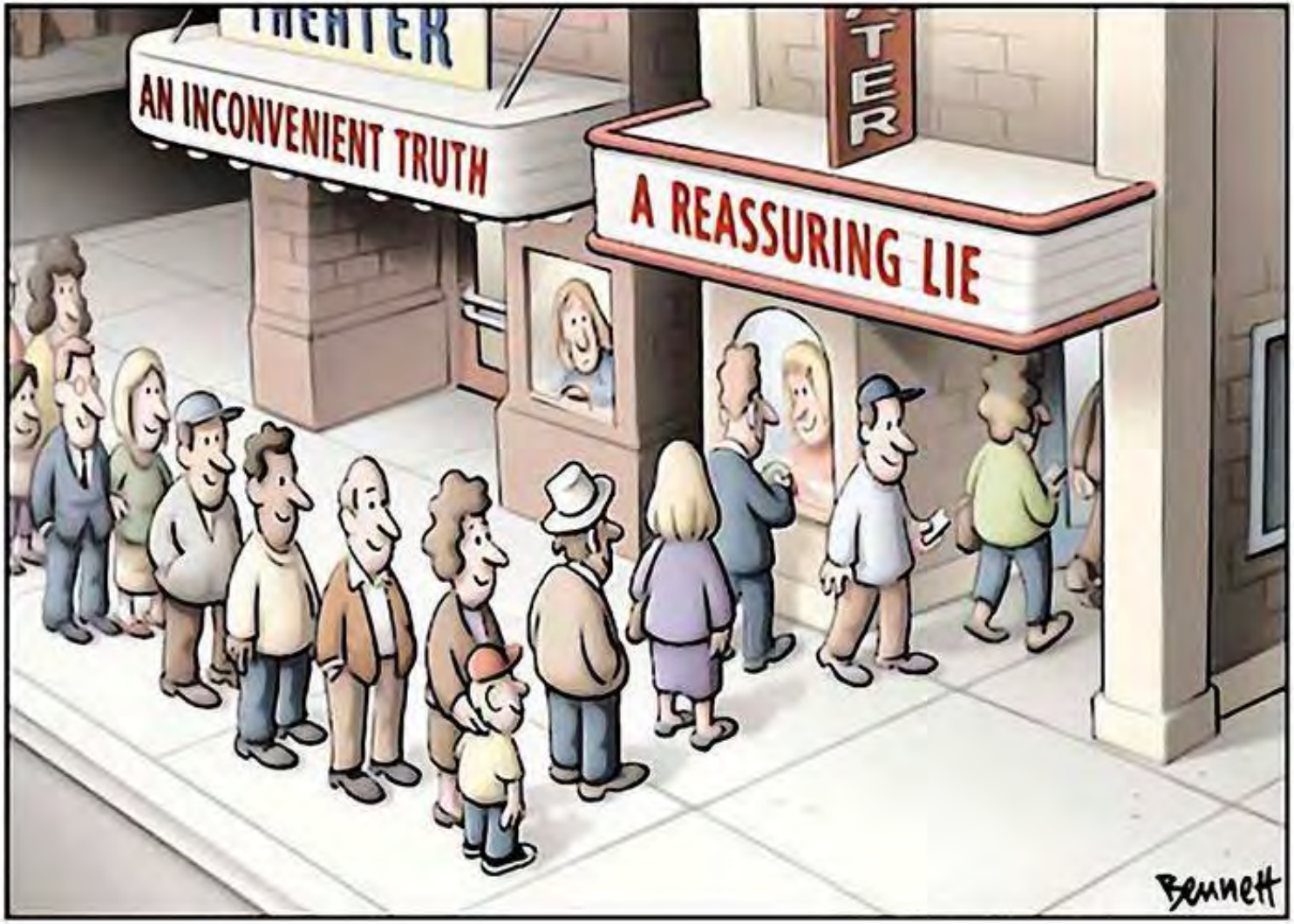
- A sustainable economy lives on its true *income*, i.e., that level of consumption that does not deplete its income-producing capital (real wealth). Eco-deficits are not allowed!
- This implies a 'steady-state' economy based on a constant or modestly fluctuating through-put of energy and material ('natural income') that leaves capital intact.
- A steady-state is not stagnant The economy does not grow but does *develop* dynamically. Society steadily improves as technologies evolve, new industries replace old, and human well-being increases.

What's to fear? What's not to like??

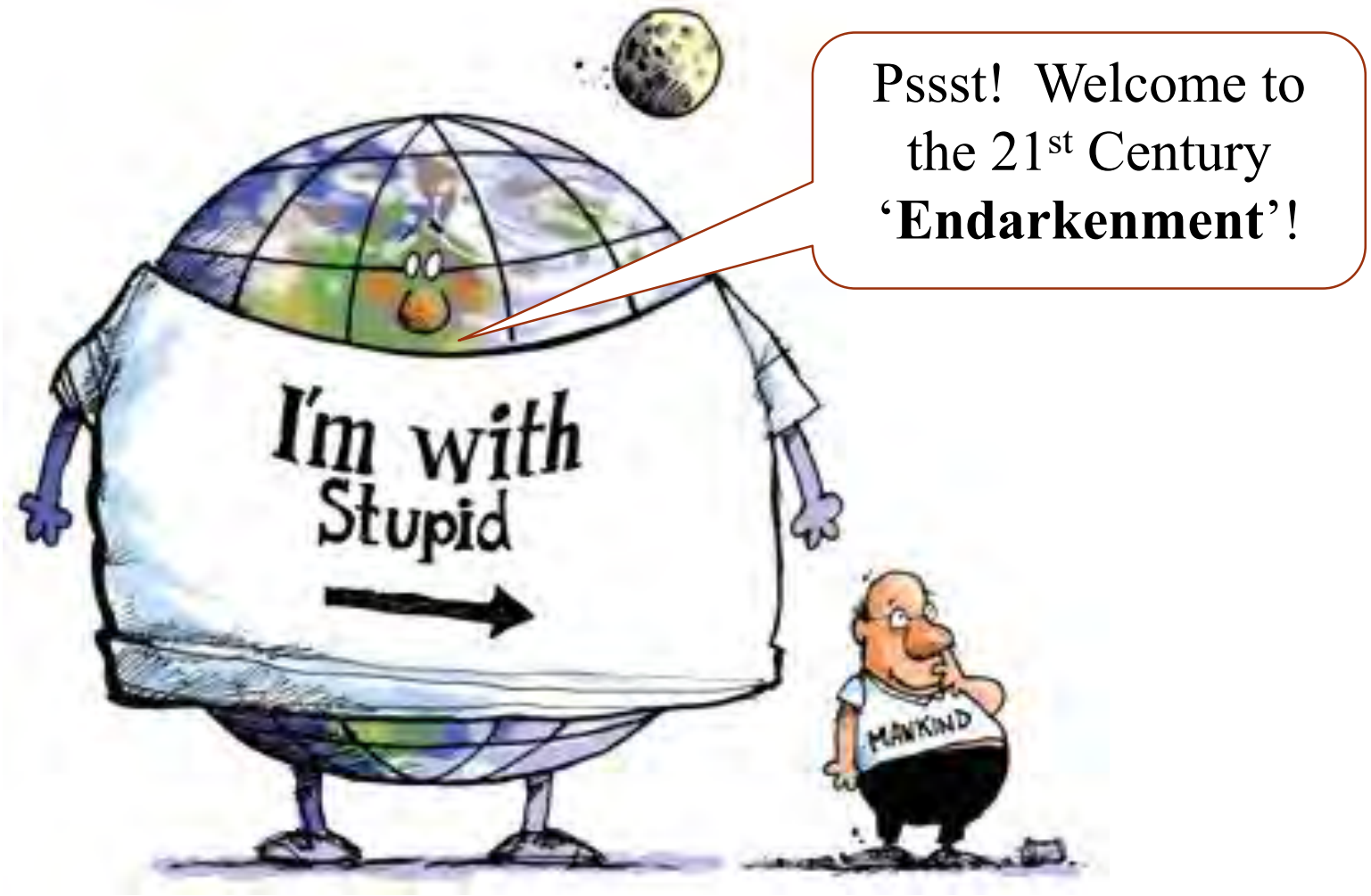
Problem: A World in Denial

- "The masses have never thirsted after truth. They turn aside from evidence that is not to their taste, preferring to deify error…" (Gustave le Bon 1896).
- "For us to maintain our way of living, we must… tell lies to each other, and especially to ourselves… [the lies] are necessary because without them many deplorable acts would become impossibilities" (Jensen 2000).
- To make matters worse, *this is the new age of unreason, the deliberate social construction of misinformation.*

We have been socially engineered to ignore reality



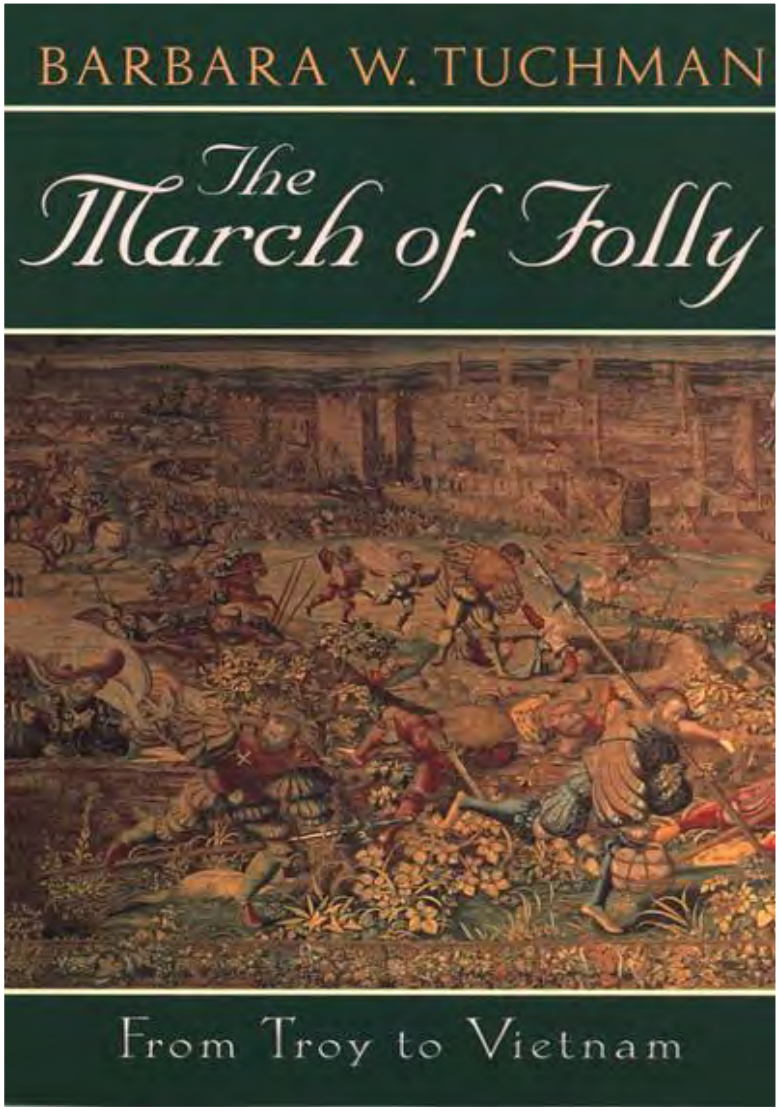
This is a new ‘age of unreason’: Science denial and magical thinking



The Power of Paradigm (i.e., political ideology) to Override Reason

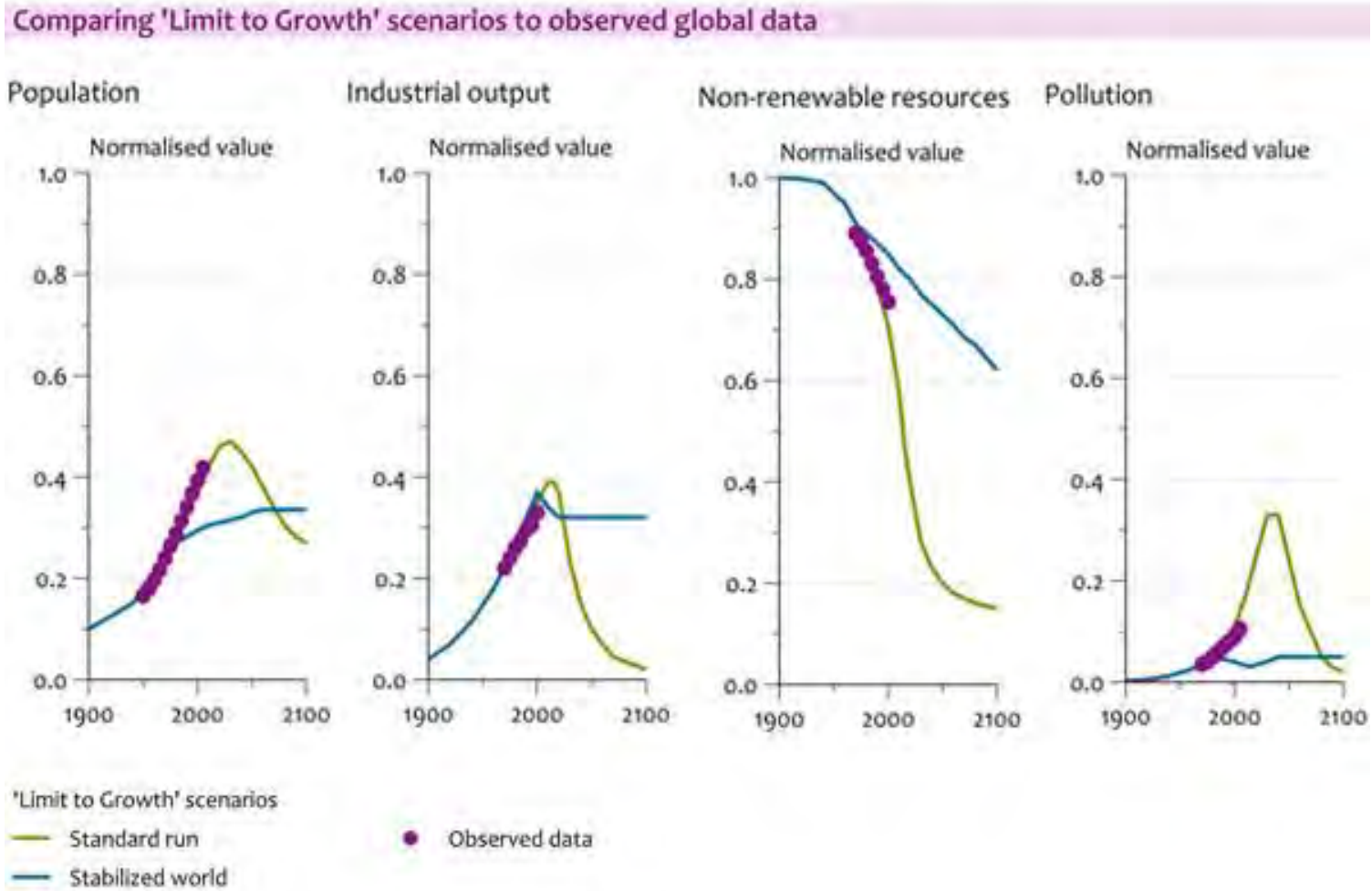
- Politicians often show willful ignorance; blindness to scientific data and analysis (deep denial);
- Governments reject planning in favour of short-term market indicators;
- We promote crass individualism at the expense of the common good (including our collective interest in survival);
- Cooperation gives way to competitive belligerence (both in markets and international affairs).

It's an old, well-documented story



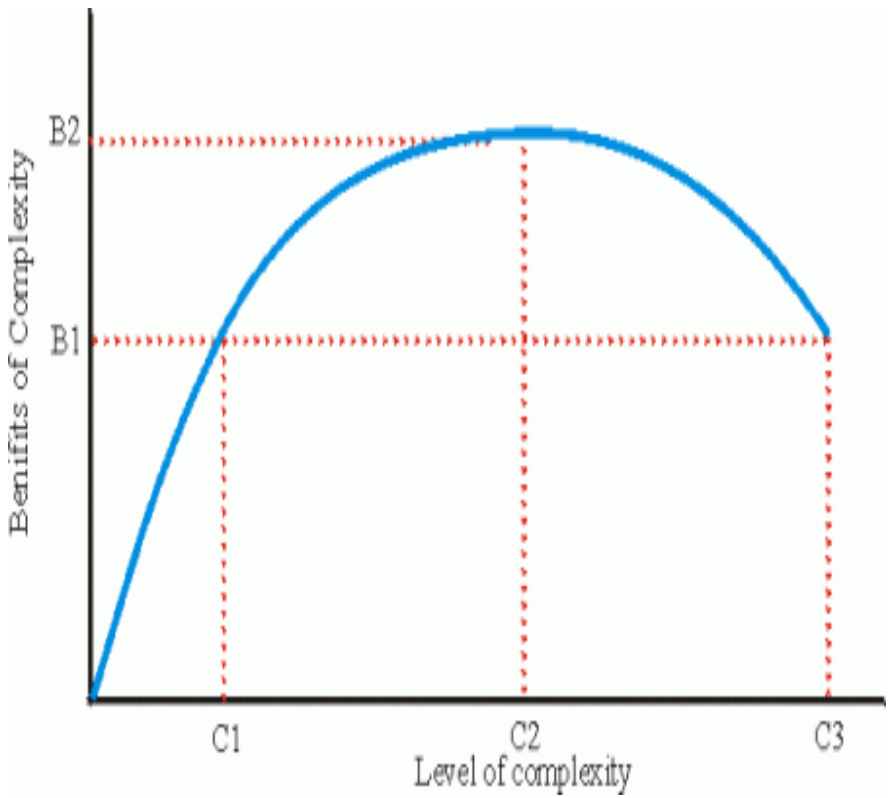
- "Why do holders of high office so often act contrary to…reason? Why does intelligent mental process so often seem not to function?"
- "Wooden-headedness... plays a remarkably large role in government. It consists in assessing a situation in terms of preconceived fixed notions [i.e., ideology] while ignoring any contrary signs. It is acting according to wish while not allowing oneself to be deflected by the facts" (Tuchman 1984).

Business as usual puts us on course for collapse



Source: *PBL Netherlands Environmental Assessment Agency*

Consider *The Collapse of Complex Societies* (Tainter 1988)



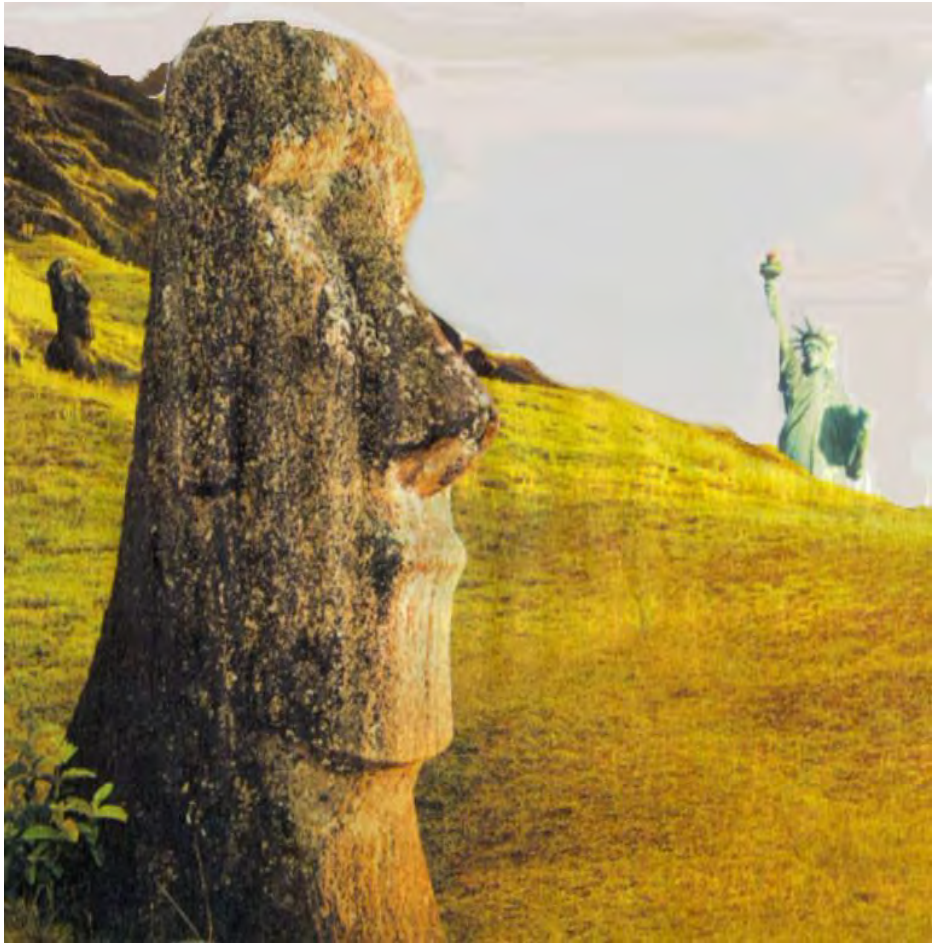
- Human societies are problem-solving systems. Each solution leads to greater societal complexity.
- But each such complexification increases the energy/material flows required to maintain the structural and functional integrity of the system.
- Eventually, "continued investment in complexity as a problem solving strategy yields a declining marginal return" in many sectors.
- Tensions, adversity and dissatisfaction build up, corruption at the top is rife, income gaps increase, ecological threats multiply, institutional incompetence is widespread.
- Society becomes incapable of coping with the next big shock. Slow decline or rapid implosion is inevitable.

Bottom Line

In coming years, the human enterprise will likely contract. As an intelligent, plan-capable moral species we can choose between:

- Business as usual – risking a chaotic implosion imposed by nature followed by geopolitical turmoil and resource wars or:
- A well-planned, orderly and cooperative descent toward a socially just sustainability for all.

It wouldn't be the first time!



- "...what is perhaps most intriguing in the evolution of human societies is the regularity with which the pattern of increasing complexity is interrupted by collapse..."
(Joseph Tainter 1995).