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# Investing in Natural and Social Capital for a Sustainable and Desirable Future

**Robert Costanza**

Gordon and Lulie Gund Professor of Ecological Economics  
and Director, Gund Institute of Ecological Economics  
Rubenstein School of Environment and Natural Resources  
The University of Vermont  
Burlington, VT 05405





# Practical Problem Solving Requires the *Integration* of:

## ¥ Vision

- a. How the world works
- b. How we would like the world to be

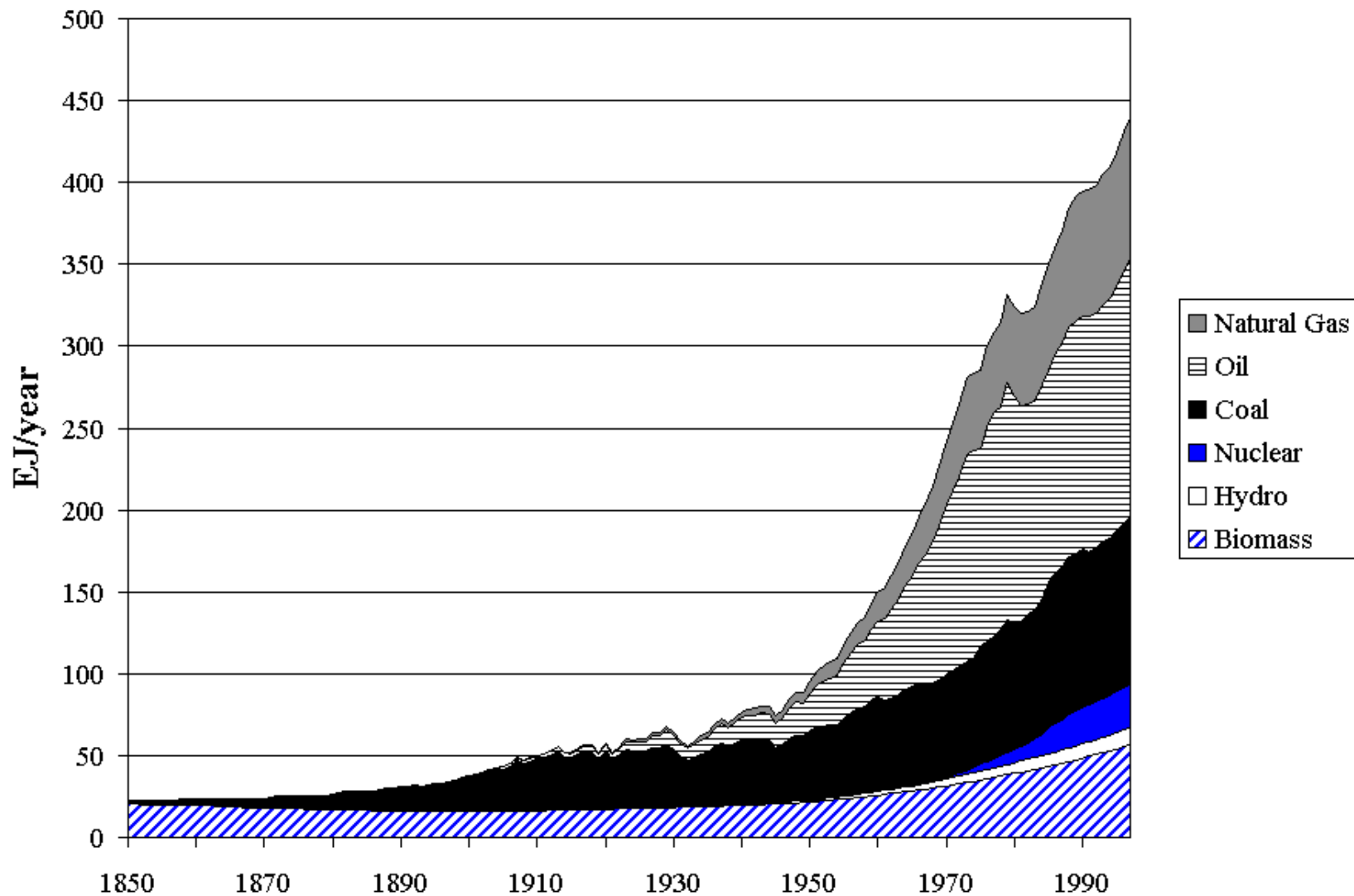
## ¥ Tools and Analysis

appropriate to the vision

## ¥ Implementation

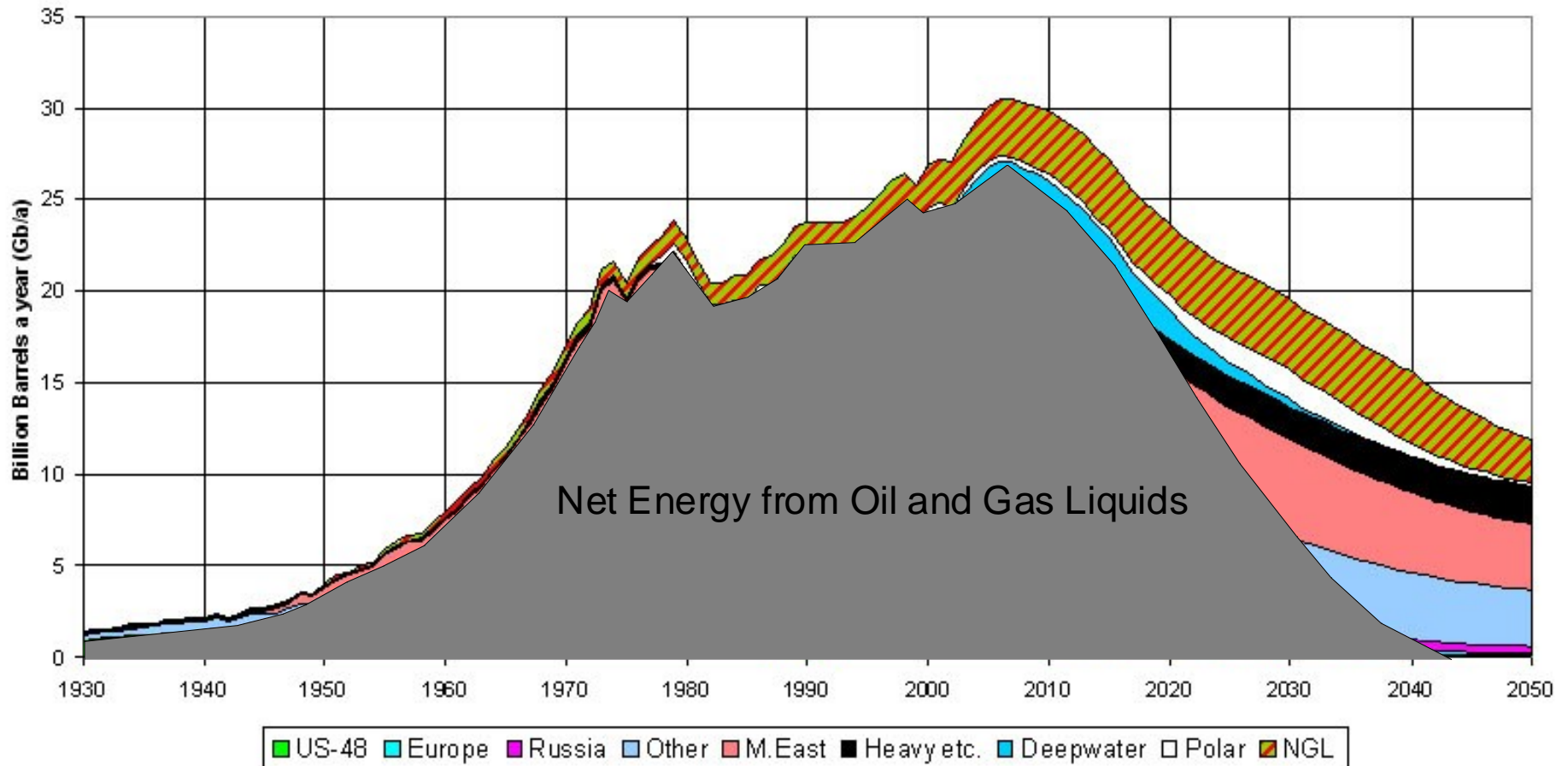
appropriate to the vision

# World Primary Energy Supply by Source, 1850-1997

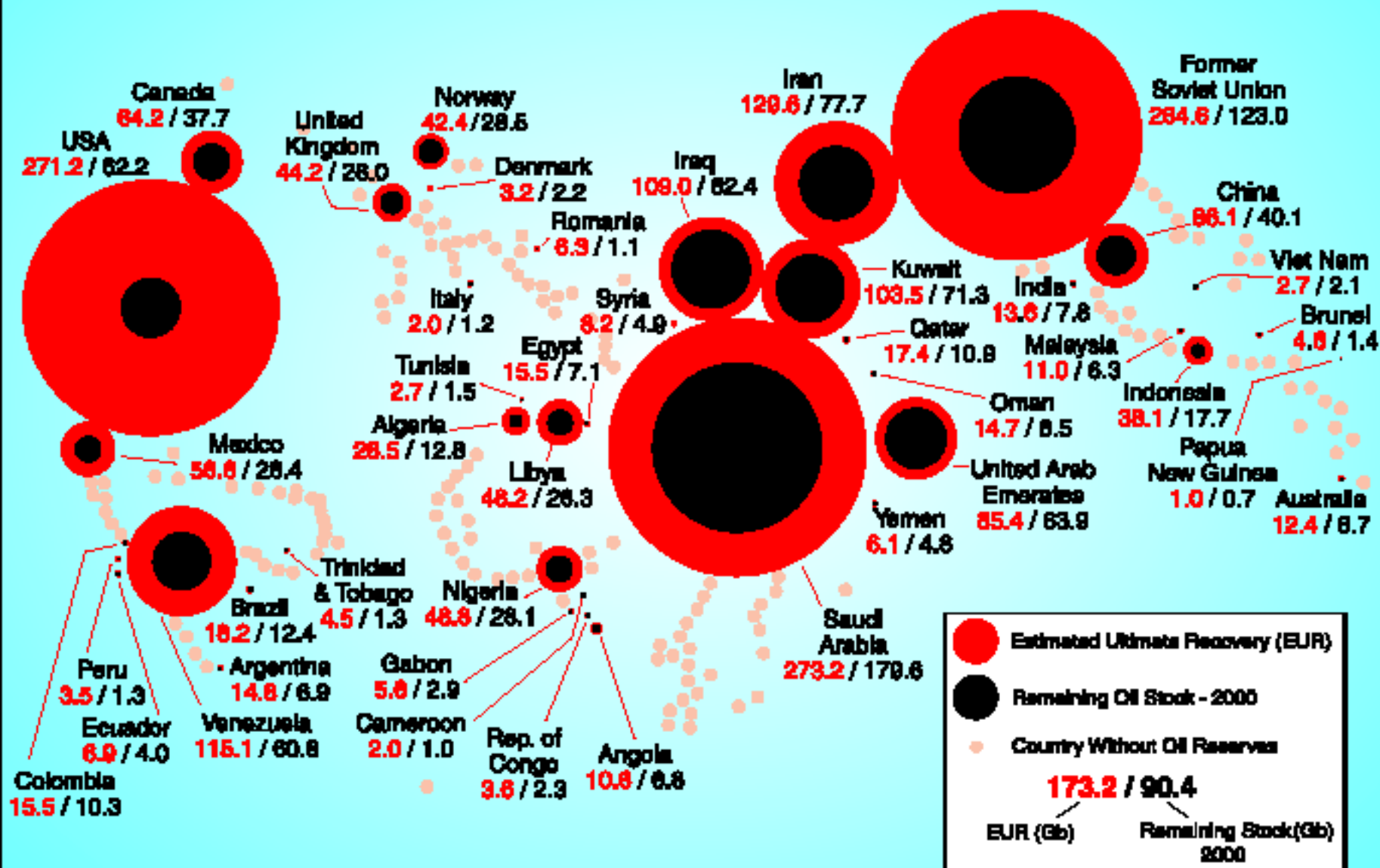


OIL AND GAS LIQUIDS 2004 Scenario  
Updated by Colin J. Campbell, 2004-05-15

**OIL AND GAS LIQUIDS  
2004 Scenario**

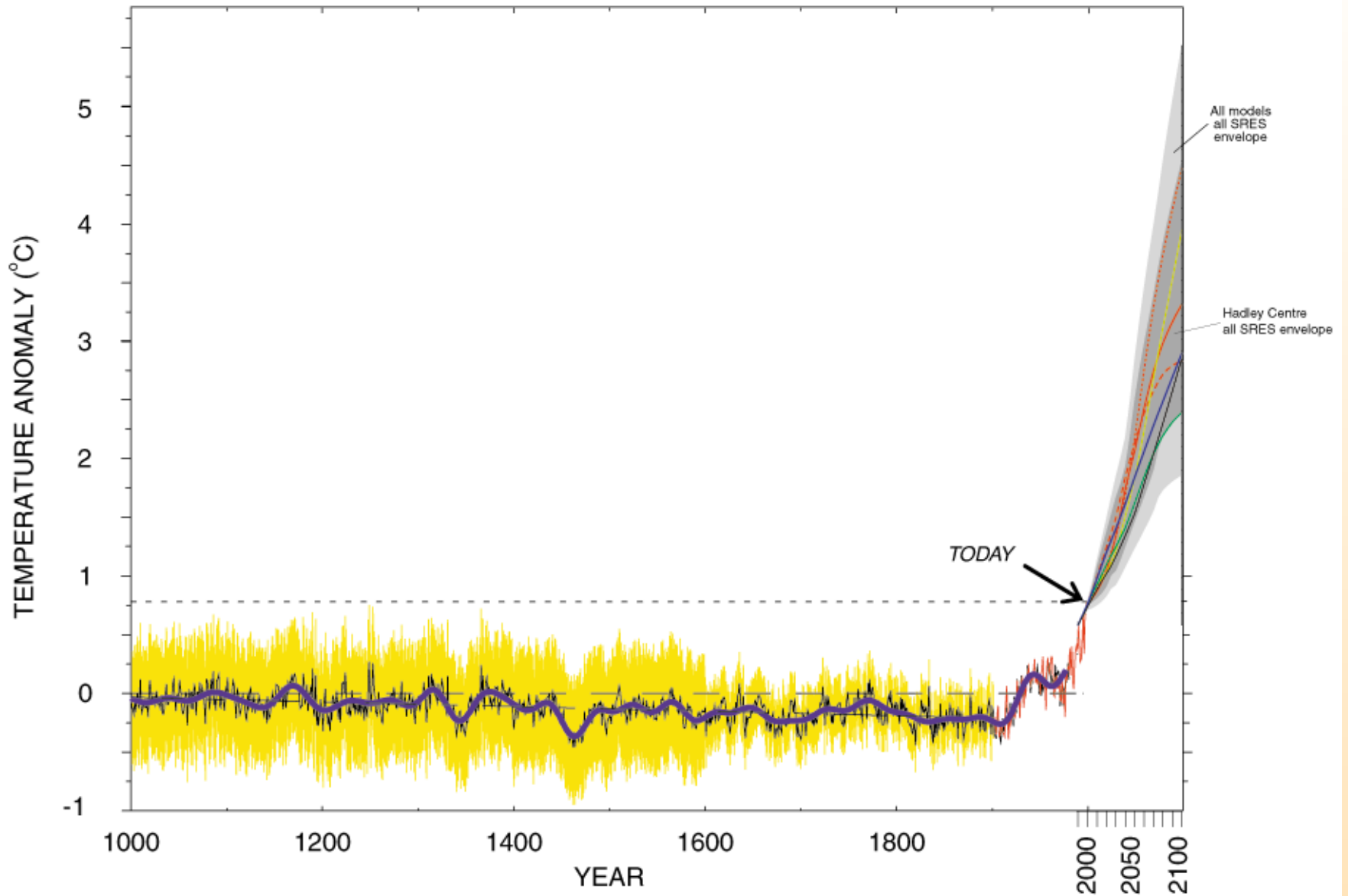


# Estimated World Oil Ultimate Recovery (EUR) and Remaining Stocks - 2000

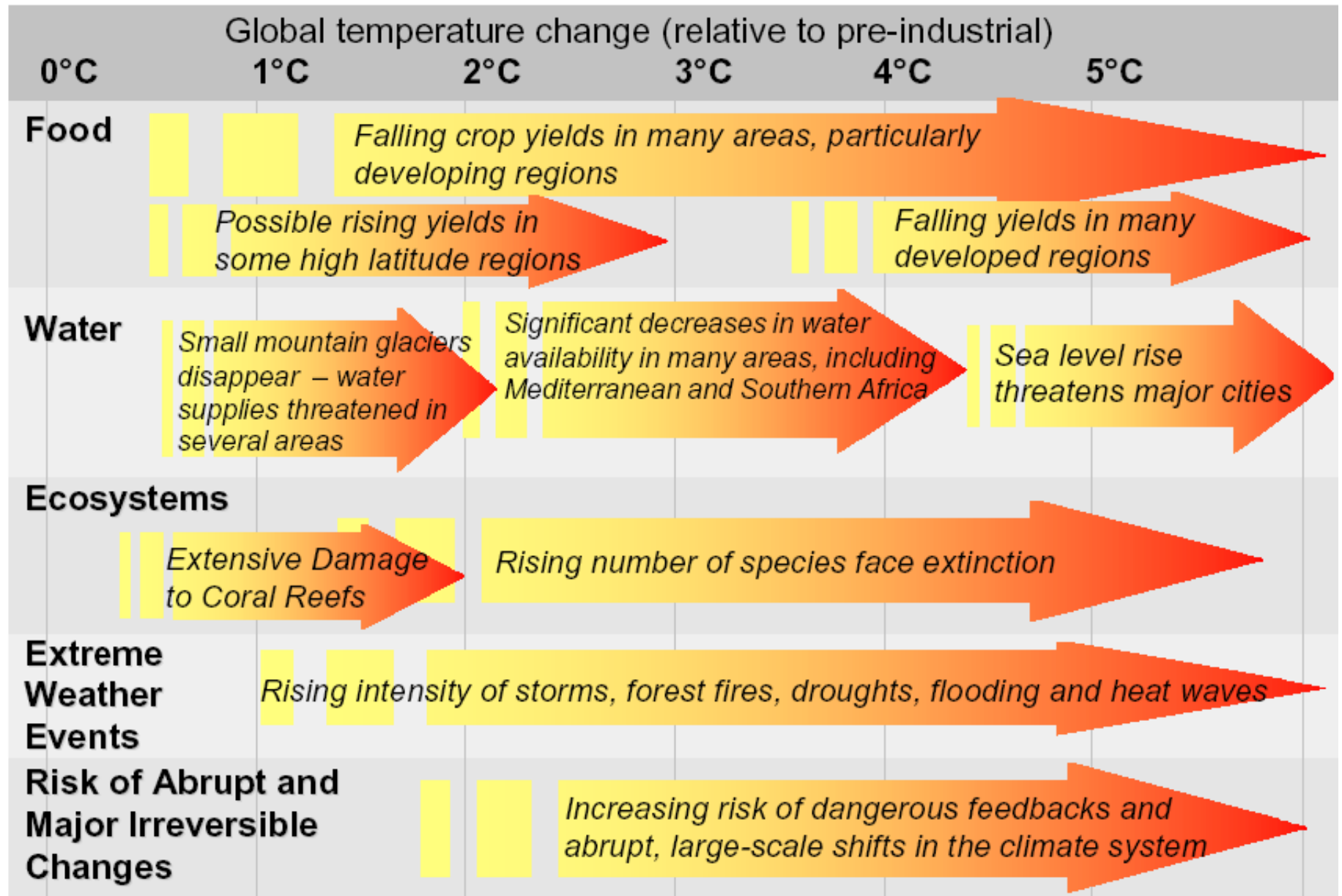


*QuickTime" and a  
decompressor  
are needed to see this picture.*

# Temperature, past and future



# Projected Impacts of Climate Change

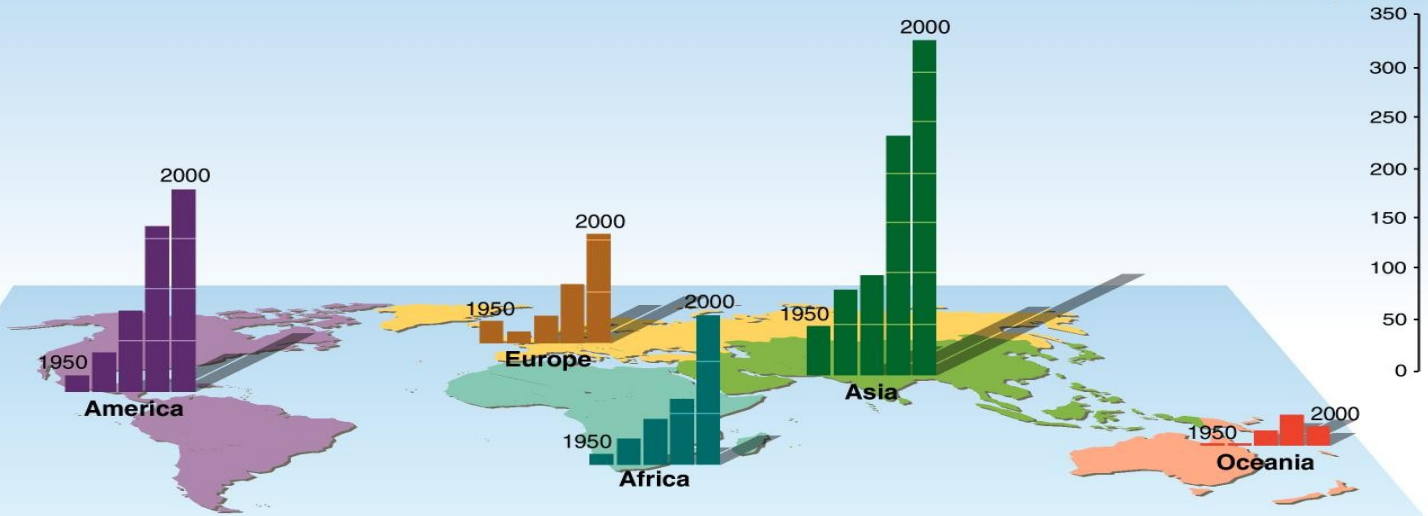


Source: Stern review on the economics of climate change, 2006



# Floods

Number of events  
Data plotted by decade



Source: Millennium Ecosystem Assessment

# Full World Anthroposphere

*QuickTime" and a  
Tinepak decompressor  
are needed to see this picture.*

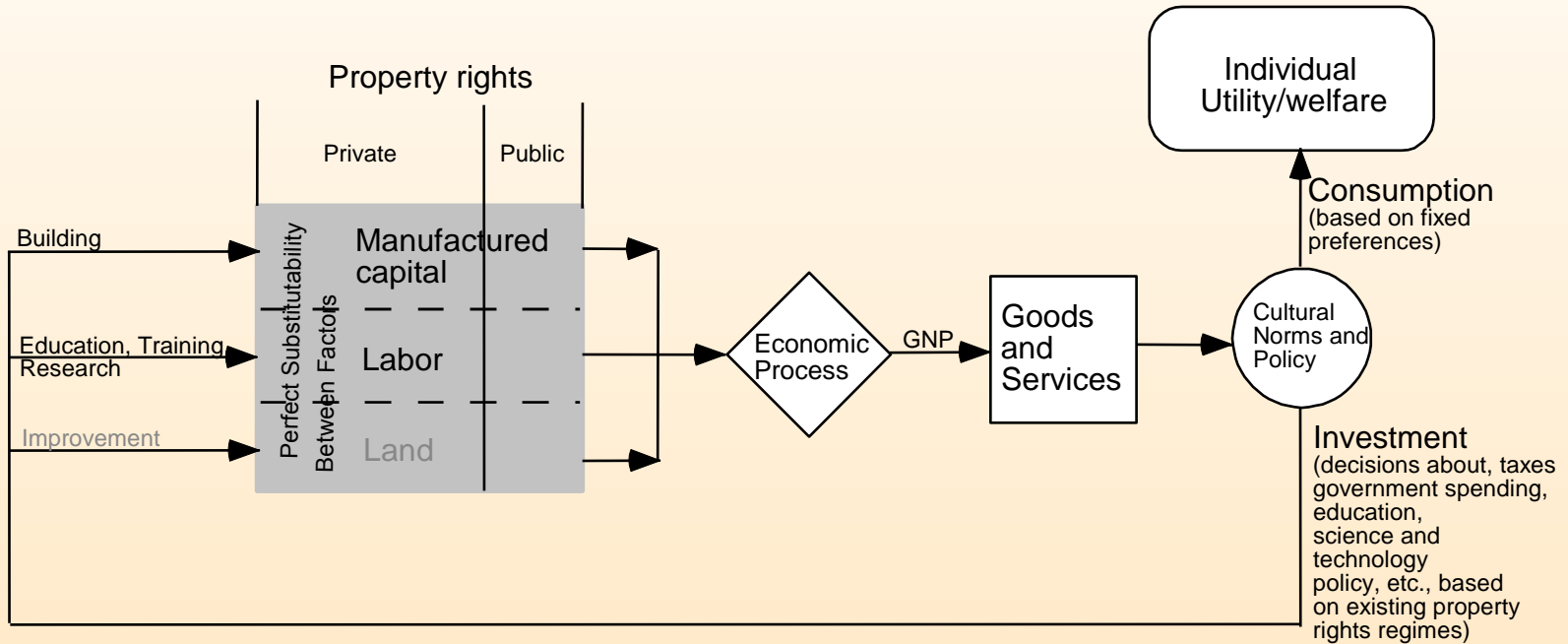
Marc  
Imhoff

Biospheric  
Sciences  
Branch

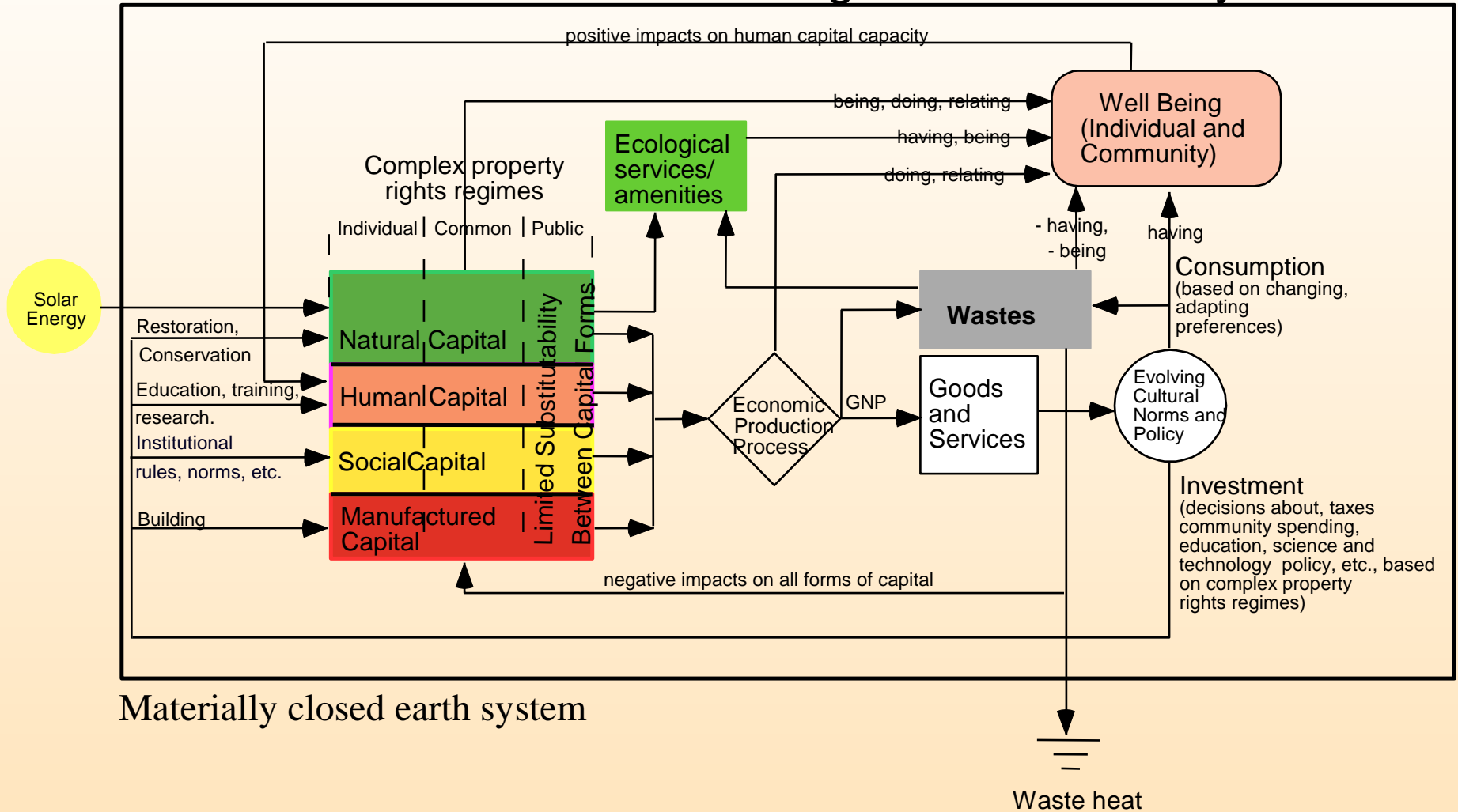
NASA

What is “the  
economy” and  
what is it for?

# "Empty World" Model of the Economy

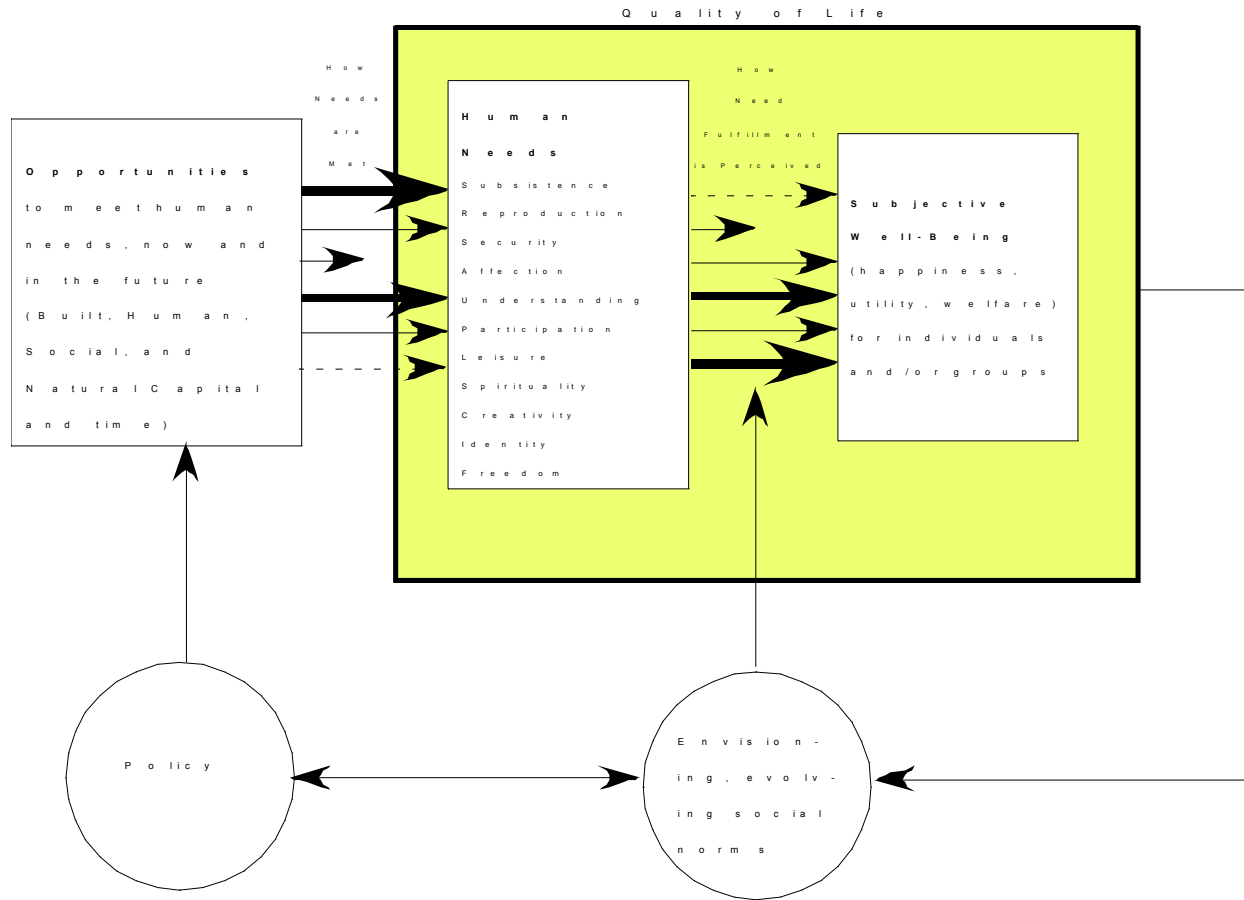


# Full World Model of the Ecological Economic System



From: Costanza, R., J. C. Cumberland, H. E. Daly, R. Goodland, and R. Norgaard. 1997. An Introduction to Ecological Economics. St. Lucie Press, Boca Raton, 275 pp.

# Quality of Life (QOL) as the interaction of human needs and the subjective perception of their fulfillment, as mediated by the opportunities available to meet the needs.



From: Costanza, R., B. Fisher, S. Ali, C. Beer, L. Bond, R. Boumans, N. L. Danigelis, J. Dickinson, C. Elliott, J. Farley, D. E. Gayer, L. MacDonald Glenn, T. Hudspeth, D. Mahoney, L. McCahill, B. McIntosh, B. Reed, S. A. T. Rizvi, D. M. Rizzo, T. Simpatico, and R. Snapp. 2006. Quality of Life: An Approach Integrating Opportunities, Human Needs, and Subjective Well-Being. *Ecological Economics* (in press).



# Ecological Economics

*oikos* = house

*logy* = study or knowledge

*nomics* = management

Literally: *management of the house (earth) based on study and knowledge of same*

## Integrated Questions/Goals:

" Ecologically Sustainable **Scale**

" Socially Fair **Distribution**

" Economically Efficient **Allocation**

## Methods:

" Transdisciplinary **Dialogue**

" **Problem** (rather than tools) **Focus**

" **Integrated Science** (balanced synthesis & analysis)

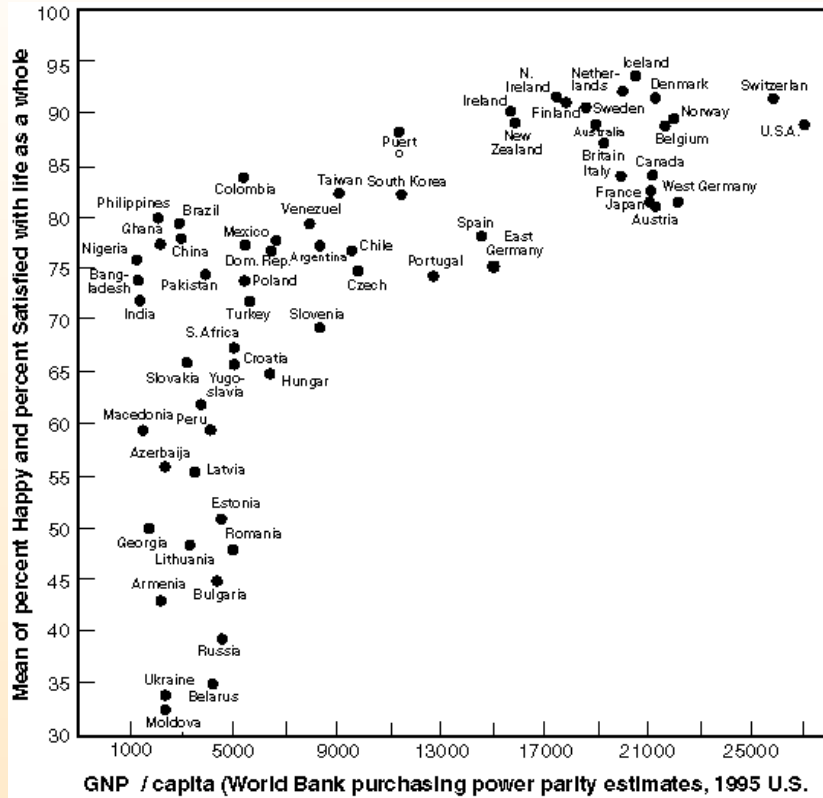
" Effective and adaptive **Institutions**

See: Costanza, R., J. C. Cumberland, H. E. Daly, R. Goodland, and R. Norgaard. 1997. An Introduction to Ecological Economics. St. Lucie Press, Boca Raton, 275 pp.

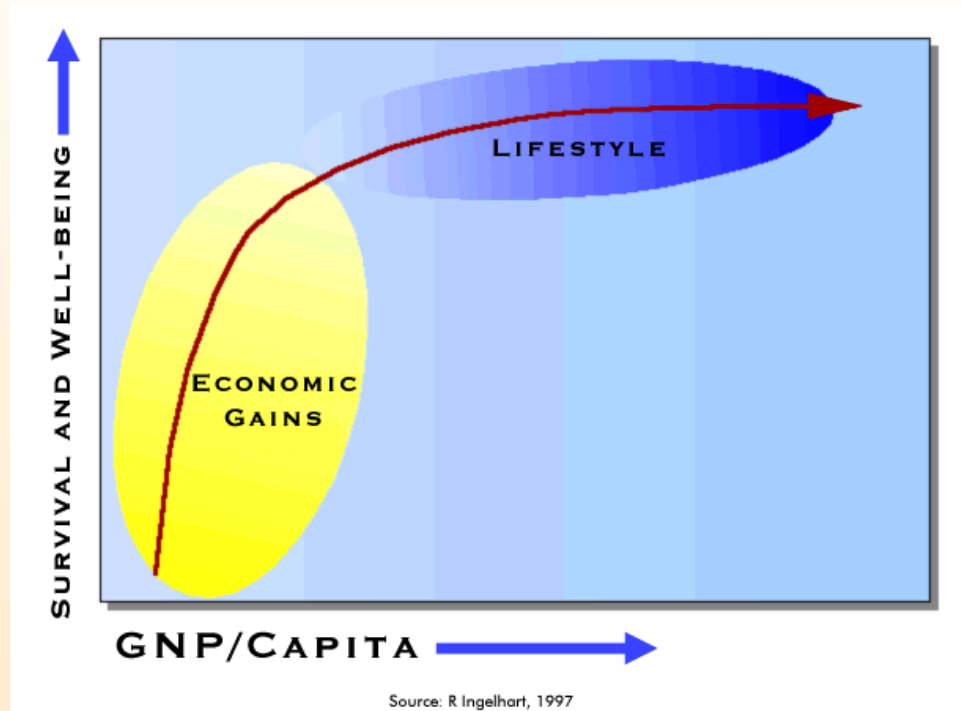
The key is developing a better understanding of the opportunities to create a sustainable future with a high quality of life



# COOL POWERPOINT 1-from ESR

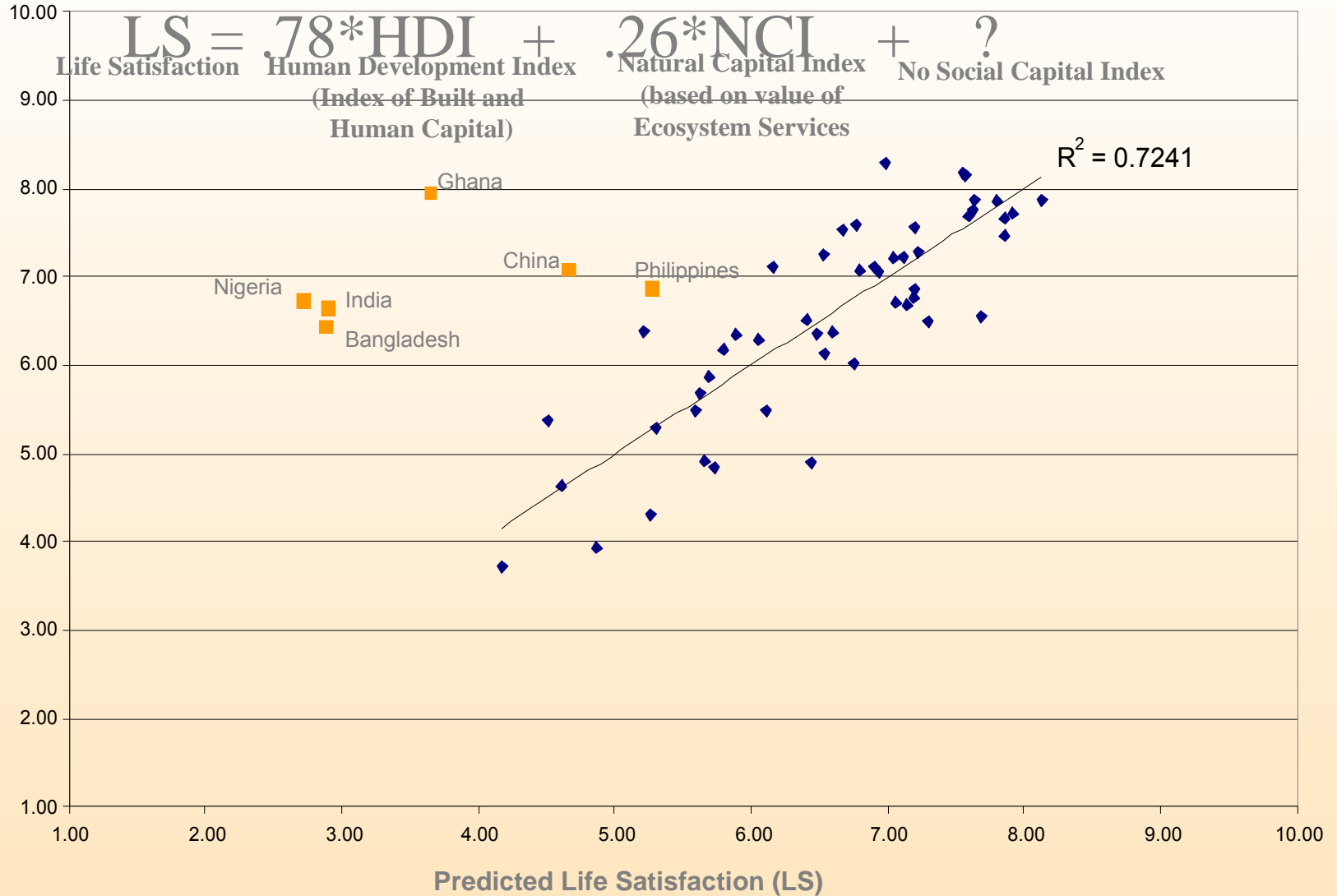


**Figure 2. Subjective well-being by level of economic development.**  
 Source: World Values Surveys; GNP/capita purchasing power estimates from World Bank, World Development Report, 1997.  
 R = .70 N = 65 p < .0000



Source: R. Inglehart, 1997

# Observed Life Satisfaction versus Predicted Life Satisfaction



From: Vemuri, A. W. and R. Costanza. 2006. The Role of Human, Social, Built, and Natural Capital in Explaining Life Satisfaction at the Country Level: Toward a National Well-Being Index (NWI). *Ecological Economics* (in press).

# Genuine Progress Indicator (or ISEW) by Column

Additions

Column A: Personal Consumption Expenditures  
Column B: Income Distribution  
Column C: Personal Consumption Adjusted for Income Inequality  
Column D: Value of Household Labor  
Column E: Value of Volunteer Work  
Column F: Services of Household Capital  
Column G: Services Highways and Street

Column H: Cost of Crime

Column I: Cost of Family Breakdown

Column J: Loss of Leisure Time

Column K: Cost of Underemployment

Column L: Cost of Consumer Durables

Column M: Cost of Commuting

Column N: Cost of Household Pollution Abatement

Column O: Cost of Automobile Accidents

Column P: Cost of Water Pollution

Column Q: Cost of Air Pollution

Column R: Cost of Noise Pollution

Column S: Loss of Wetlands

Column T: Loss of Farmland

Column U: Depletion of Nonrenewable Resources

Column V: Long-Term Environmental Damage

Column W: Cost of Ozone Depletion

Column X: Loss of Forest Cover

Column Y: Net Capital Investment

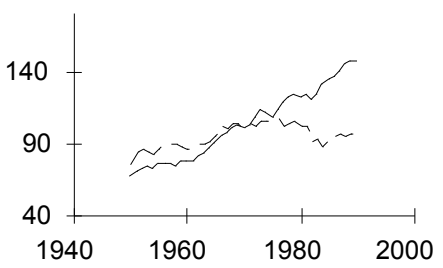
Column Z: Net Foreign Lending and Borrowing

■ Built Capital  
■ Human Capital  
■ Social Capital  
■ Natural Capital

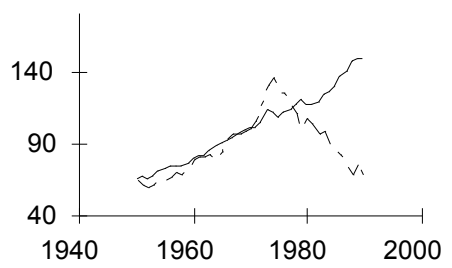
Subtractions

# Indices of ISEW – – (Index of Sustainable Economic Welfare) and GDP ——— (1970 = 100)

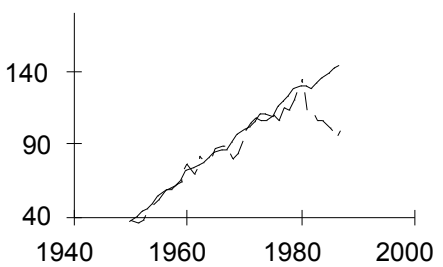
**US**



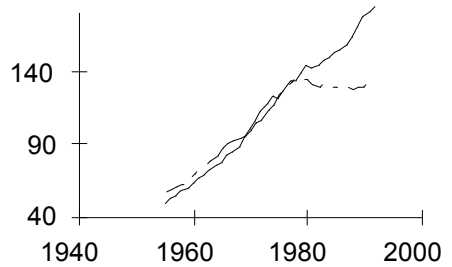
**UK**



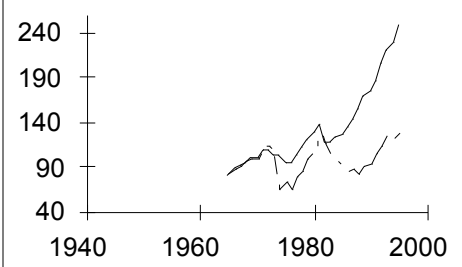
**Germany**



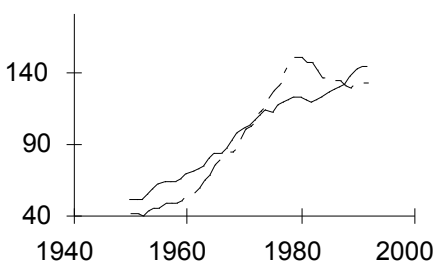
**Austria**



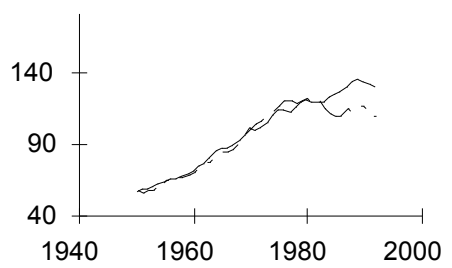
**Chile**

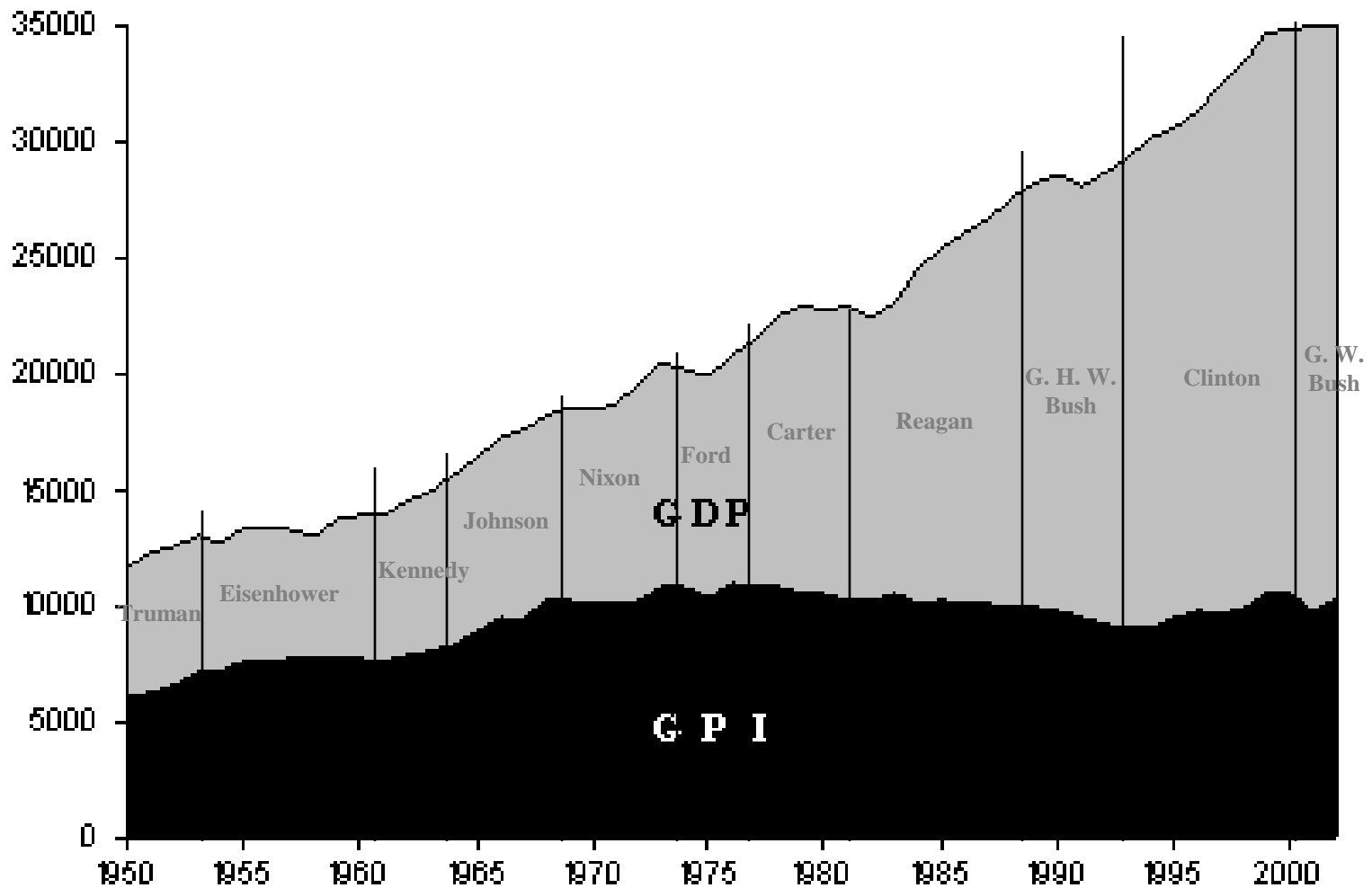


**Netherlands**



**Sweden**

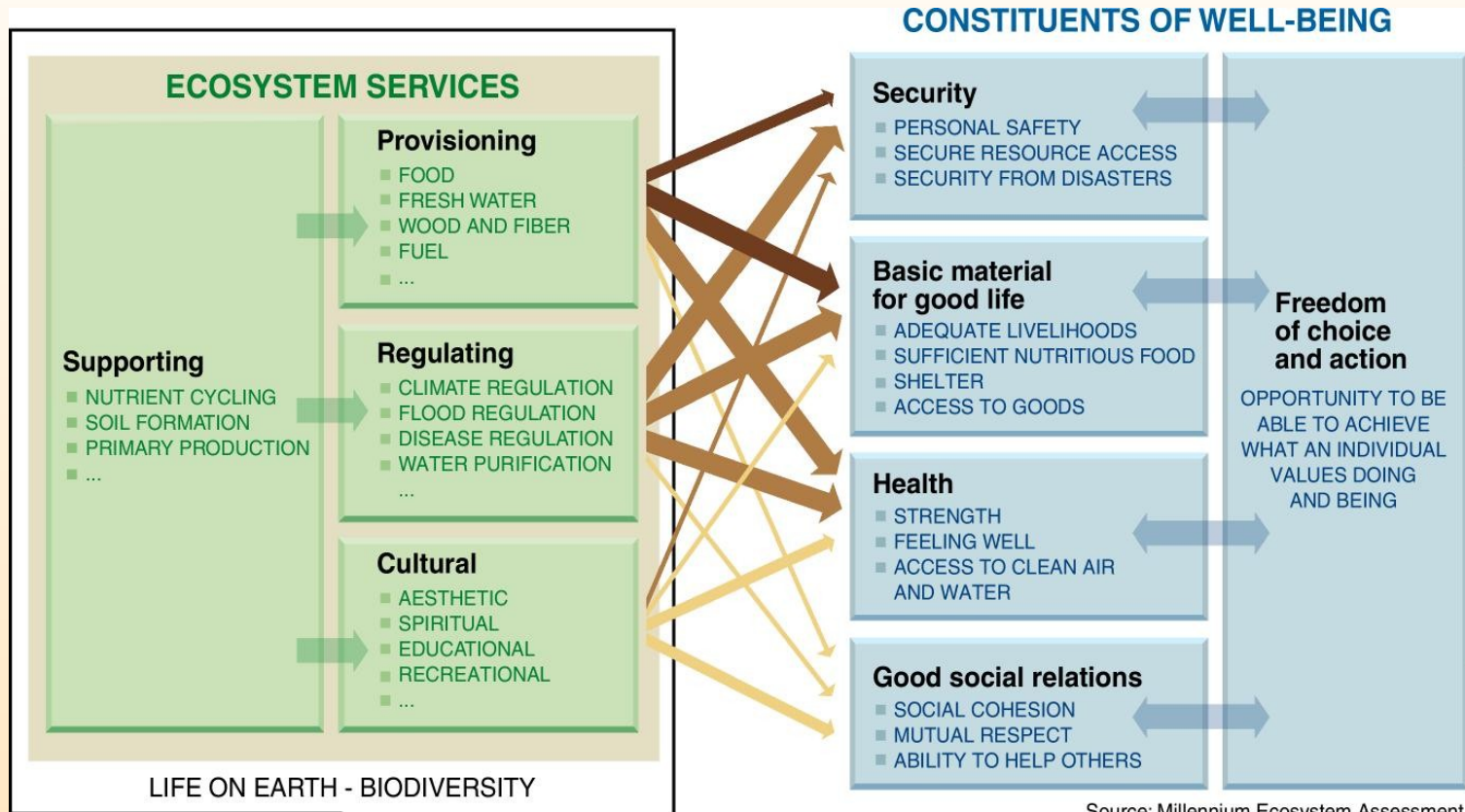




## Gross Production vs. Genuine Progress for the US, 1950 to 2002

(source: Redefining Progress - <http://www.rprogress.org>)

# Ecosystem Services: the benefits humans derive from ecosystems



Source: Millennium Ecosystem Assessment

**ARROW'S COLOR**  
Potential for mediation by socioeconomic factors

- Low
- Medium
- High

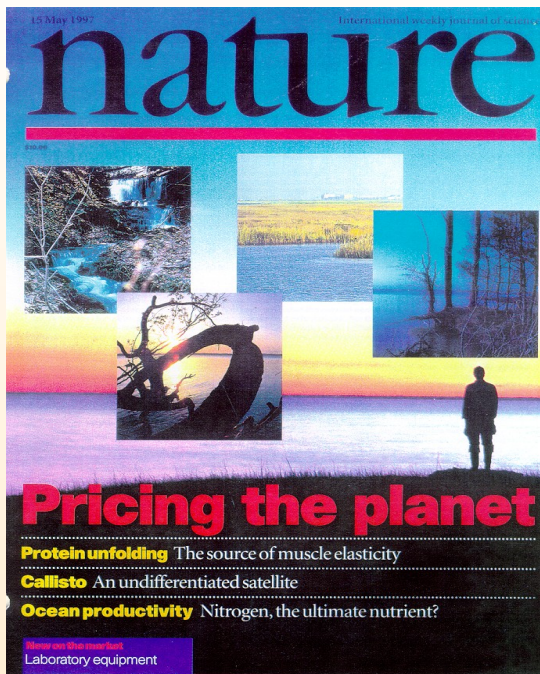
**ARROW'S WIDTH**  
Intensity of linkages between ecosystem services and human well-being

- Weak
- Medium
- Strong

# Biosphere

*QuickTime" and a  
decompressor  
are needed to see this picture.*

Sea-viewing Wide Field-of-View Sensor (SeaWiFS)  
data on marine and terrestrial plant productivity



NATURE | VOL 387 | 15 MAY 1997 253

article

# The value of the world's ecosystem services and natural capital

Robert Costanza\*†, Ralph d'Arge‡, Rudolf de Groot§, Stephen Farber, Monica Grasso†, Bruce Hannon¶, Karin Limburg#, Shahid Naeem\*\*, Robert V. O'Neill††, Jose Paruelo‡‡, Robert G. Raskin§§, Paul Suttonkk & Marjan van den Belt¶¶

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§ Center for Environment and Climate Studies, Wageningen Agricultural University, PO Box 9101, 6700 HB Wageningen, The Netherlands

k Graduate School of Public and International Affairs, University of Pittsburgh, Pittsburgh, Pennsylvania 15260, USA

¶ Geography Department and NCSA, University of Illinois, Urbana, Illinois 61801, USA

# Institute of Ecosystem Studies, Millbrook, New York, USA

\*\* Department of Ecology, Evolution and Behavior, University of Minnesota, St Paul, Minnesota 55108, USA

†† Environmental Sciences Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831, USA

‡‡ Department of Ecology, Faculty of Agronomy, University of Buenos Aires, Av. San Martin 4453, 1417 Buenos Aires, Argentina

§§ Jet Propulsion Laboratory, Pasadena, California 91109, USA

kk National Center for Geographic Information and Analysis, Department of Geography, University of California at Santa Barbara, Santa Barbara, California 93106, USA

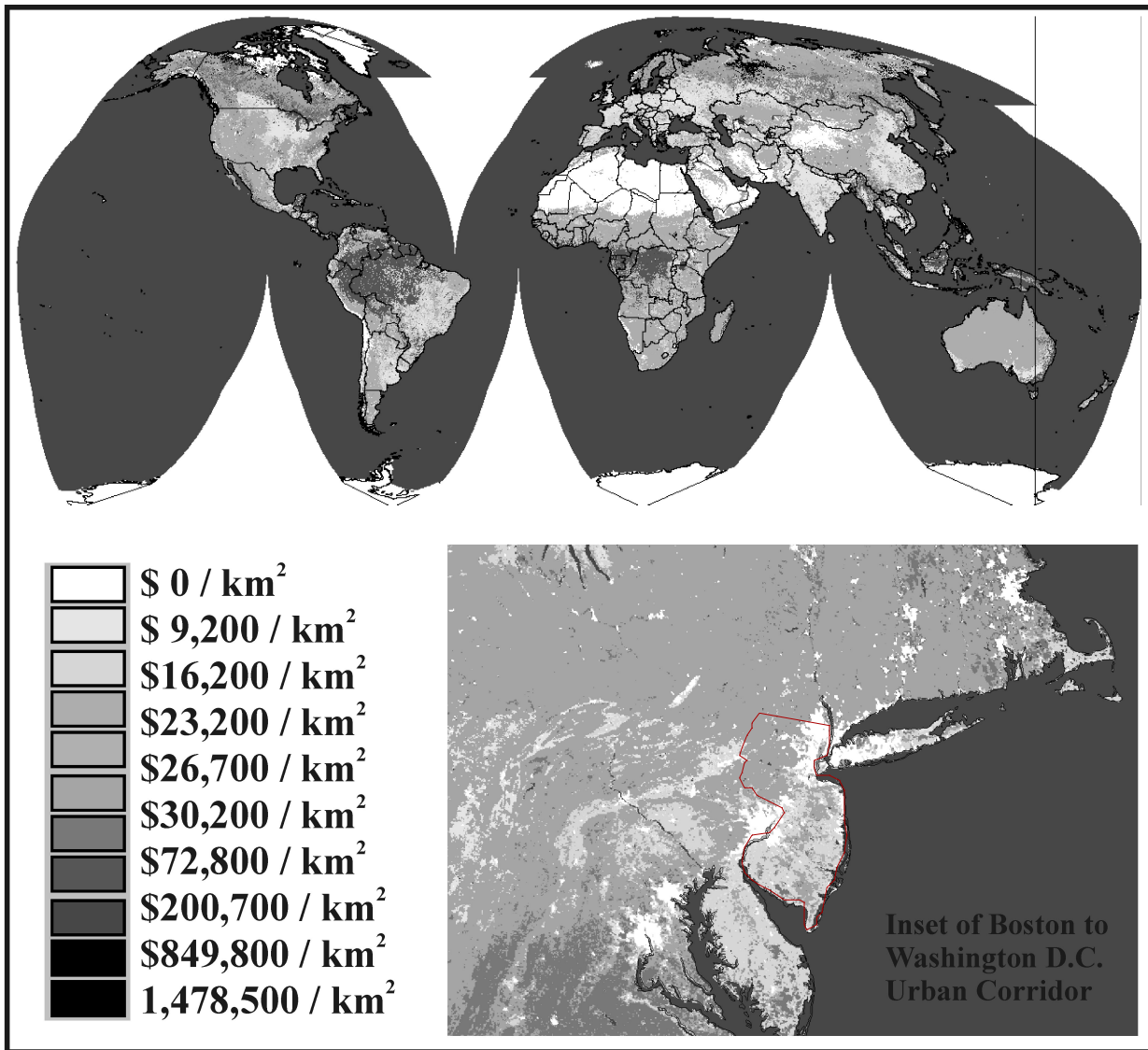
¶¶ Ecological Economics Research and Applications Inc., PO Box 1589, Solomons, Maryland 20688, USA

The services of ecological systems and the natural capital stocks that produce them are critical to the functioning of the Earth's life-support system. They contribute to human welfare, both directly and indirectly, and therefore represent part of the total economic value of the planet. We have estimated the current economic value of 17 ecosystem services for 16 biomes, based on published studies and a few original calculations. For the entire biosphere, the value (most of which is outside the market) is estimated to be in the range of US\$16–54 trillion (10<sup>12</sup>) per year, with an average of US\$33 trillion per year. Because of the nature of the uncertainties, this must be considered a minimum estimate. Global gross national product total is around US\$18 trillion per year.

2<sup>nd</sup> most cited article in the last 10 years in the Ecology/Environment area according to the ISI Web of Science.

# Summary of global values of annual ecosystem services (From: Costanza et al. 1997)

<b>Biome</b>	<b>Area (e6 ha)</b>	<b>Value per ha (\$/ha/yr)</b>	<b>Global Flow Value (e12 \$/yr)</b>
<b>Marine</b>	<b>36,302</b>	<b>577</b>	<b>20.9</b>
Open Ocean	33,200	252	8.4
Coastal	3,102	4052	12.6
Estuaries	180	22832	4.1
Seagrass/Algae Beds	200	19004	3.8
Coral Reefs	62	6075	0.3
Shelf	2,660	1610	4.3
<b>Terrestrial</b>	<b>15,323</b>	<b>804</b>	<b>12.3</b>
Forest	4,855	969	4.7
Tropical	1,900	2007	3.8
Temperate/Boreal	2,955	302	0.9
Grass/Rangelands	3,898	232	0.9
Wetlands	330	14785	4.9
Tidal Marsh/Mangroves	165	9990	1.6
Swamps/Floodplains	165	19580	3.2
Lakes/Rivers	200	8498	1.7
Desert	1,925		
Tundra	743		
Ice/Rock	1,640		
Cropland	1,400	92	0.1
Urban	332		
<b>Total</b>	<b>51,625</b>		<b>33.3</b>



**Figure 3: Global Map of Non-Marketed Economic Activity (ESP) arising from Ecosystem Services and derived from Land Cover at 1 km<sup>2</sup> (For National Totals See Table 1)**



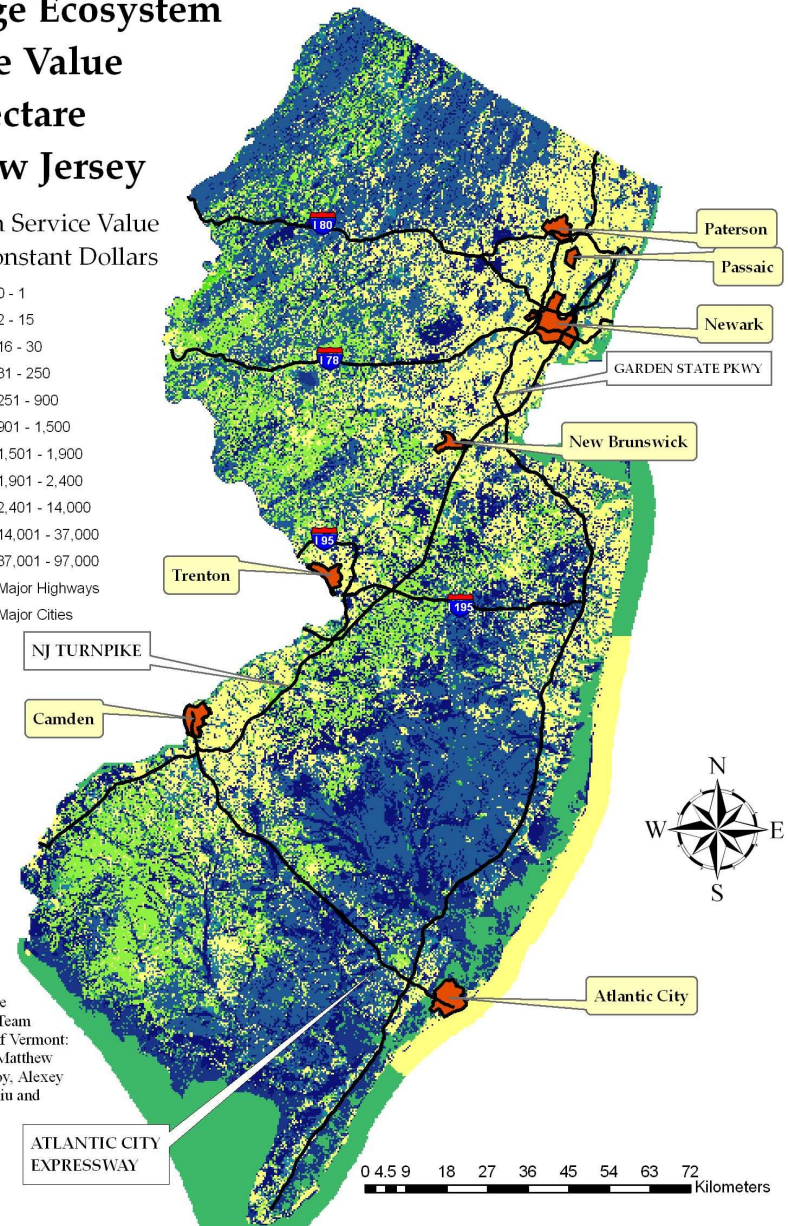
# Valuing New Jersey's Natural Capital:

*An Assessment of the Economic Value of the State's Natural Resources*  
April 2007



## Average Ecosystem Service Value per Hectare for New Jersey

Ecosystem Service Value in 2001 Constant Dollars

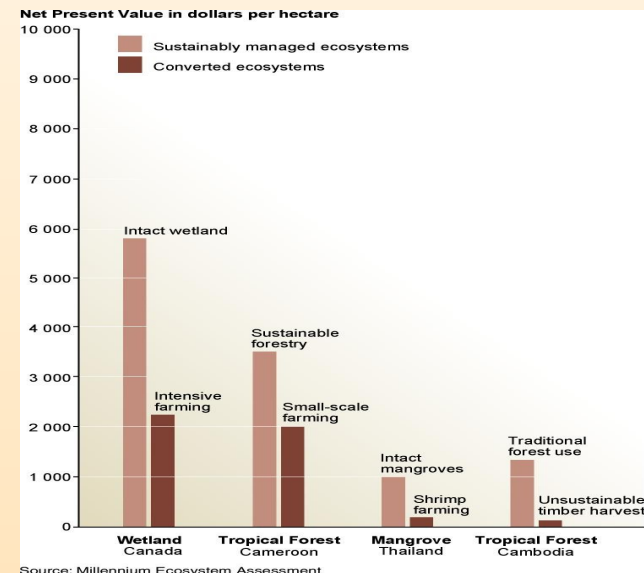


The New Jersey Ecosystem Service Valuation Project Team at the University of Vermont: Robert Costanza, Matthew Wilson, Austin Troy, Alexey Voinov, Shuang Liu and John D'Agostino

Map Produced by Austin Troy and John D'Agostino

# Degradation of ecosystem services often causes significant harm to human well-being

- The total economic value associated with managing ecosystems more sustainably is often higher than the value associated with conversion
- Conversion may still occur because private economic benefits are often greater for the converted system



# Economic Reasons for Conserving Wild Nature

**Costs** of expanding and maintaining the current global reserve network to one covering 15% of the terrestrial biosphere and 30% of the marine biosphere = \$US 45 Billion/yr

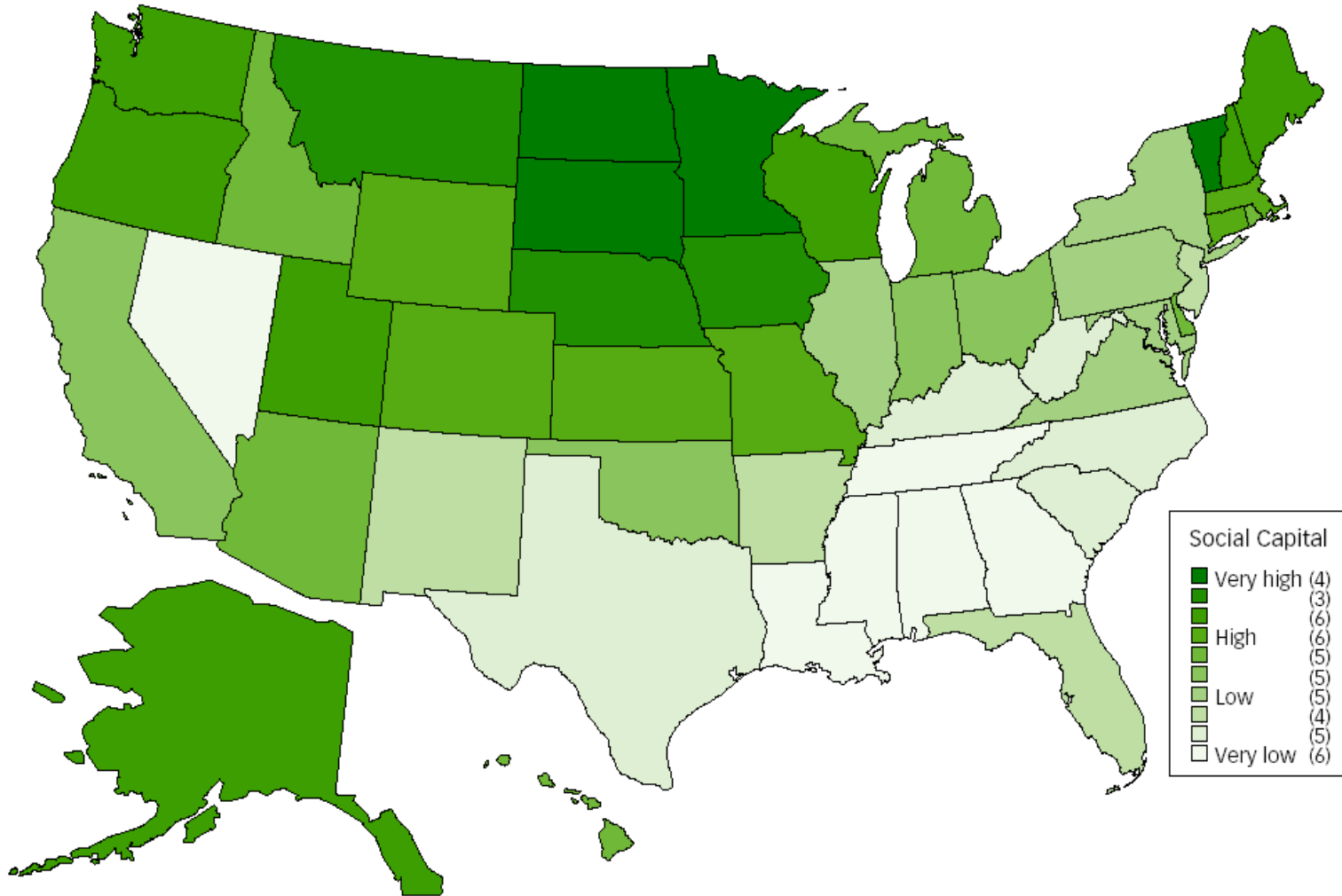
**Benefits** (Net value\* of ecosystem services from the global reserve network) = \$US 4,400-5,200 Billion/yr

\*Net value is the difference between the value of services in a wild state and the value in the most likely human-dominated alternative

**Benefit/Cost Ratio = 100:1**

(From: Balmford, A., A. Bruner, P. Cooper, R. Costanza, S. Farber, R. E. Green, M. Jenkins, P. Jefferiss, V. Jessamy, J. Madden, K. Munro, N. Myers, S. Naeem, J. Paavola, M. Rayment, S. Rosendo, J. Roughgarden, K. Trumper, and R. K. Turner 2002. Economic reasons for conserving wild nature. *Science* 297: 950-953)

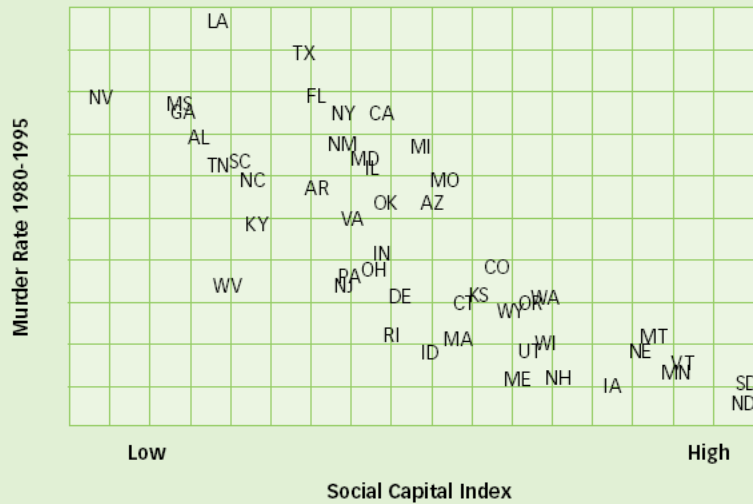
## Social Capital index by State



From: R. Putnam, *Bowling Alone: The Collapse and Revival of American Community* (New York: Simon and Schuster, 2000).

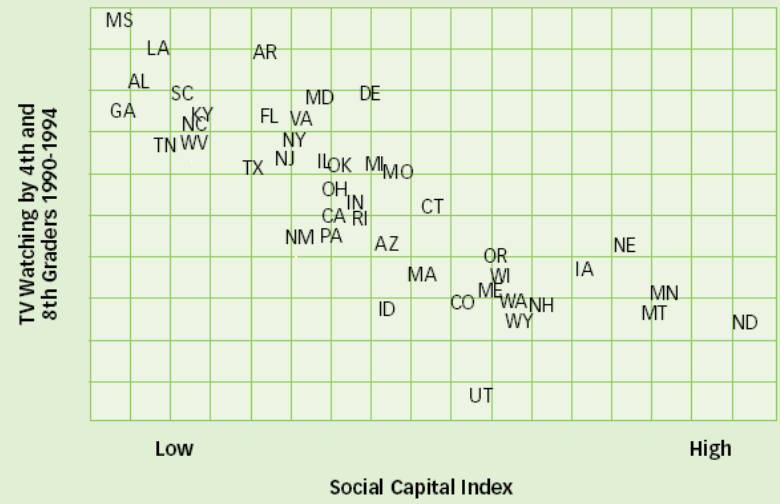
**FIGURE 7.4**

**Violent crime is rarer in high social capital states**



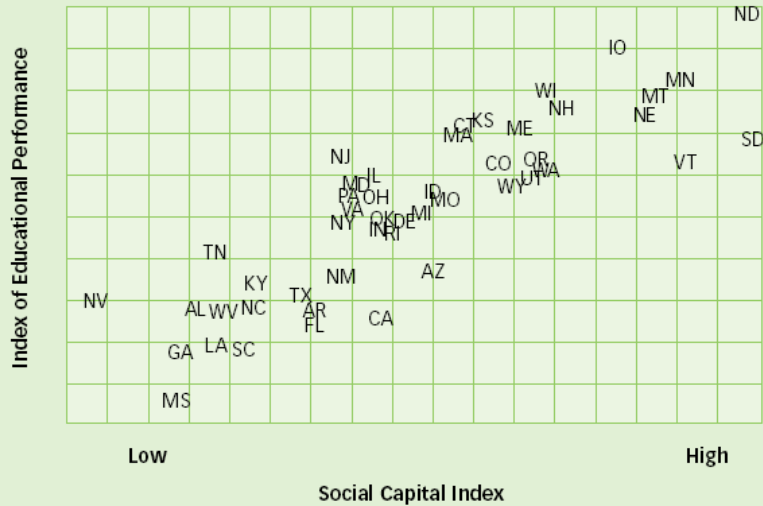
**FIGURE 7.3**

**Kids watch less TV in high social capital states**



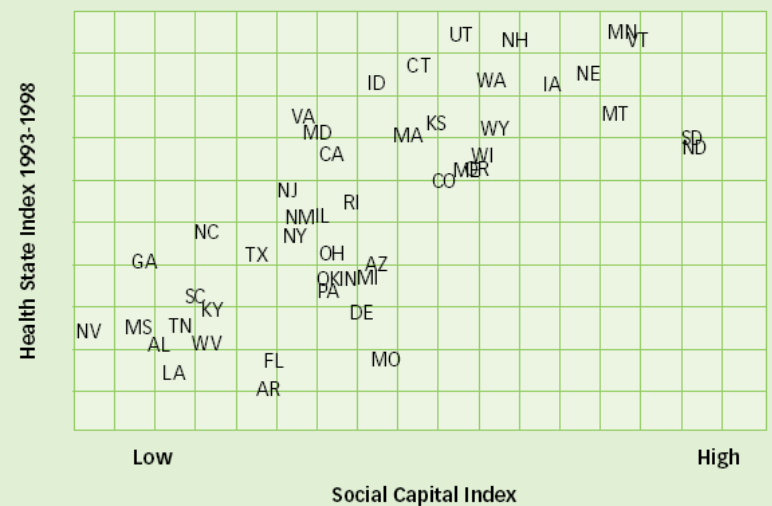
**FIGURE 7.1**

**Schools work better in high social capital states**



**FIGURE 7.6**

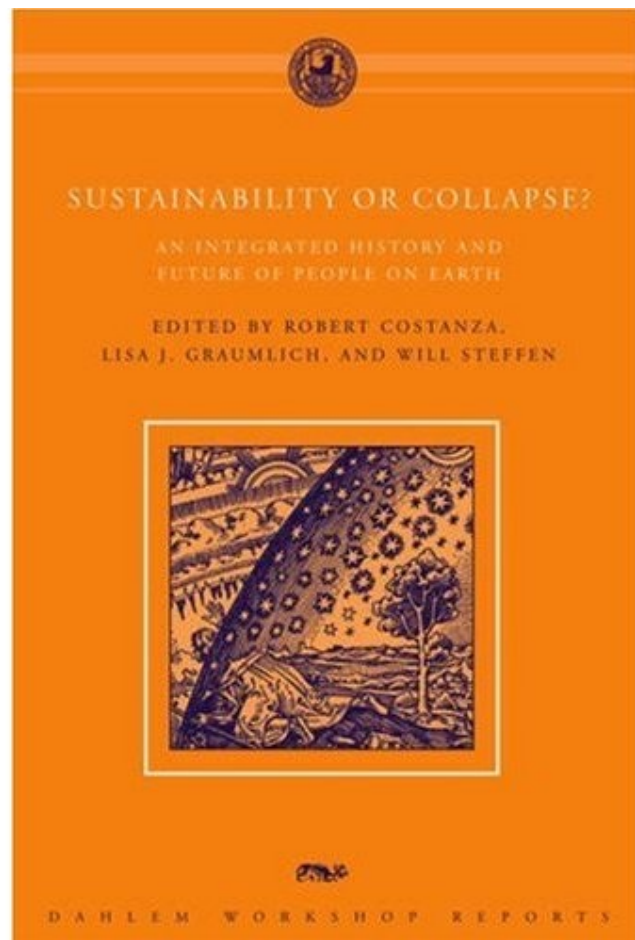
**Health is better in high social capital states**



# SUSTAINABILITY OR COLLAPSE?

## AN INTEGRATED HISTORY AND FUTURE OF PEOPLE ON EARTH

EDITED BY ROBERT COSTANZA, LISA J. GRAUMLICH, AND WILL STEFFEN

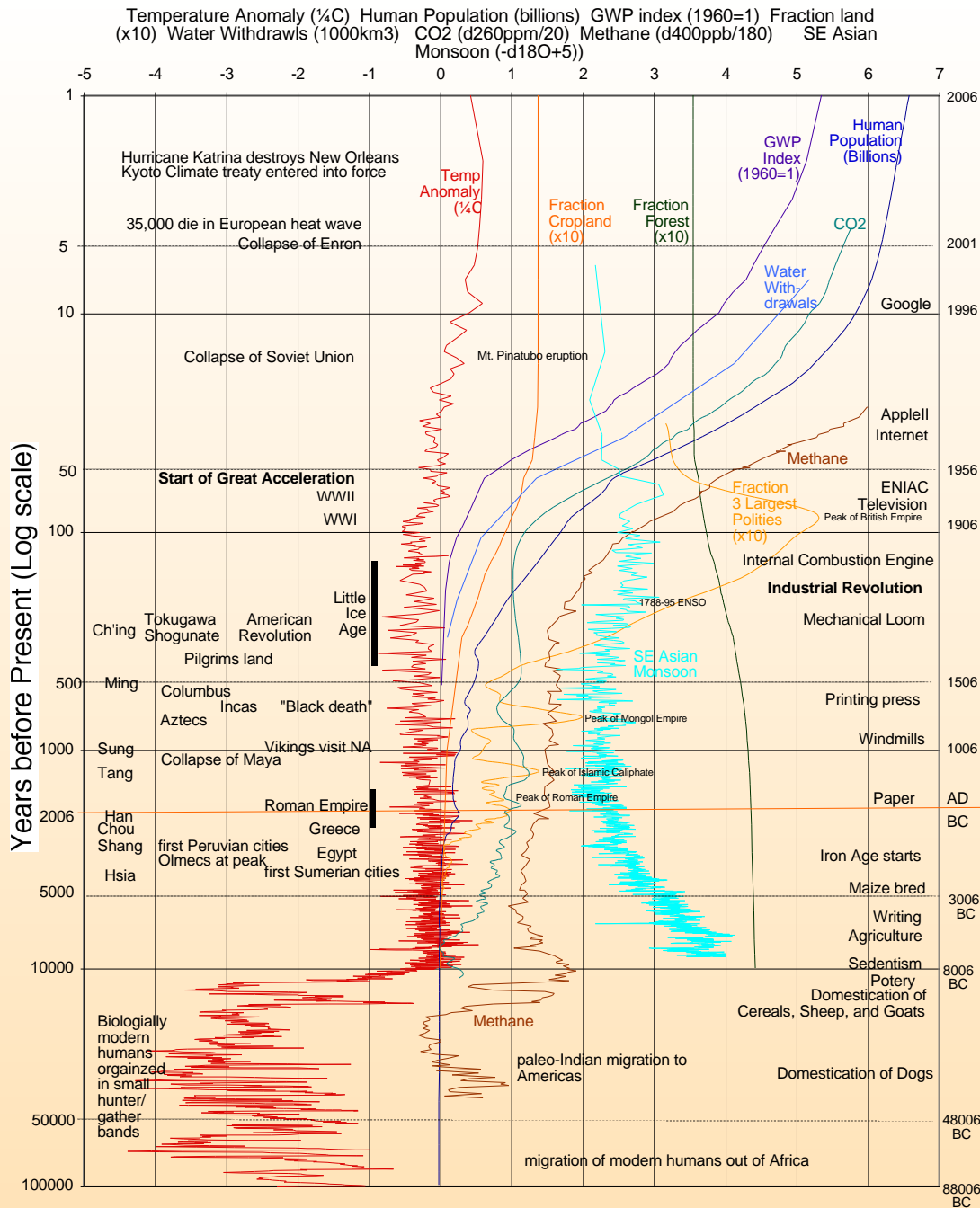


Human history, as written traditionally, leaves out the important ecological and climate context of historical events. But the capability to integrate the history of human beings with the natural history of the Earth now exists, and we are finding that human-environmental systems are intimately linked in ways we are only beginning to appreciate. In *Sustainability or Collapse?*, researchers from a range of scholarly disciplines develop an integrated human and environmental history over millennial, centennial, and decadal time scales and make projections for the future. The contributors focus on the human-environment interactions that have shaped historical forces since ancient times and discuss such key methodological issues as data quality. Topics highlighted include the political ecology of the Mayans; the effect of climate on the Roman Empire; the "revolutionary weather" of El Niño from 1788 to 1795; twentieth-century social, economic, and political forces in environmental change; scenarios for the future; and the accuracy of such past forecasts as *The Limits to Growth*.

*"Costanza, Graumlich, and Steffen have assembled an amazing group of scholars from the biophysical and social sciences and the humanities; together, they take a long look back so as to take a better look forward. The resulting book offers a deep understanding of what the future has to offer—both the risks and the opportunities that face humanity."*

**ELINOR OSTROM**  
ARTHUR F. BENTLEY PROFESSOR OF POLITICAL SCIENCE AND  
CO-DIRECTOR OF THE WORKSHOP IN POLITICAL THEORY AND  
POLICY ANALYSIS, INDIANA UNIVERSITY

**ROBERT COSTANZA** is Gordon Gund Professor of Ecological Economics and Director of the Gund Institute for Ecological Economics at the Rubenstein School of Environment and Natural Resources at the University of Vermont. **LISA J. GRAUMLICH** is Executive Director of the Big Sky Institute for Science and Natural History and Professor of Land Resources and Environmental Sciences at Montana State University. **WILL STEFFEN** is Director of the Center for Resource and Environmental Studies and Director of the ANU Institute of Environment at the Australian National University and Chief Scientist at the International Geosphere-Biosphere Programme, Stockholm.



# Integrated History and future Of People on Earth

From: Costanza, R. L. Graumlich, W. Steffen, C. Crumley, J. Dearing, K. Hibbard, R. Leemans, C. Redman, and D. Schimel. 2007. Sustainability or Collapse: What Can We Learn from Integrating the History of Humans and the Rest of Nature? *Ambio* (in press).

# Adaptive Institutions Consistent with the Vision

## **Lisbon Principles of Sustainable Governance:**

**" Responsibility**

**" Scale-Matching**

**3. Precaution**

**4. Adaptive Management**

**5. Full Cost Allocation**

**6. Participation**

**From:** Costanza, R. F. Andrade, P. Antunes, M. van den Belt, D. Boersma, D. F. Boesch, F. Catarino, S. Hanna, K. Limburg, B. Low, M. Molitor, G. Pereira, S. Rayner, R. Santos, J. Wilson, M. Young. 1998. Principles for sustainable governance of the oceans. *Science* 281:198-199.

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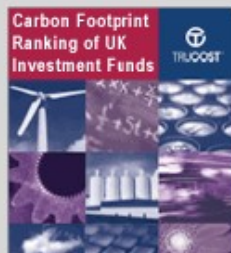
 Environment Agency  
Environmental Disclosures

Latest week Trading

Carbon Disclosure Project Report 2006 FTSE 350



Carbon Footprint Ranking of UK Investment Funds



## Welcome

Trucost is an environmental research organisation working with companies, investors and government agencies to understand the impacts companies have on the environment. Trucost is an independent organisation founded in 2000.



### Carbon Footprint Analysis

Are your pension fund clients and trustees asking for the carbon costs of companies in your investment portfolio?

Do you need help identifying and reporting on these?

Research on over 3,200 companies including all constituents of the MSCI All World Developed, FTSE All-Share, S&P 500, Russell 1000, ASX 200 & Nikkei 225

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Also available through RREV

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more...

Companies >>

## Tools for Companies

more...



### Received a Company Data Sheet?

▶ MORE INFO

## News

### 22nd February 2007

Trucost is delighted to have won the Sustainable and Ethical Investment and Asset Management Category at the City of London Corporation's Sustainable City Awards 2006/7.

### 19th February 2007

GLG Partners have launched a long-only fund filtering the greenest companies from its \$1.5bn European Equity Strategy. The fund uses Trucost data to find the companies in each sector with lighter environmental footprints.

### 19th February 2007

French sustainability research centre Novethic's most recent newsletter 'L'essentiel de l'ISR' examines Trucost. It talks about the company as a global resource for investors wanting to integrate the environment into the investment process.

### 29th January 2007

Trucost research reveals that less than half of the world's largest electric utilities disclose their carbon emissions to investors.

### 17th January 2007

Trucost announces a major upgrade to Trucost Online for 2007

### 15th January 2007

Trucost is to release an updated briefing on the carbon efficiency of European airlines and the implications of their inclusion in the EU ETS. The announcement follows the appearance of Simon Thomas, Chief Executive,



# Making the market tell the truth

In general, privatization is **NOT** the answer, because most ecosystem services are public goods. But we do need to adjust market incentives to send the right signals to the market. These methods include:

"Full cost accounting (i.e. [www.trucost.org](http://www.trucost.org),  
[www.earthinc.org](http://www.earthinc.org))

"Ecological tax reform (tax bads not goods, remove perverse subsidies)

"Ecosystem service payments (a la Costa Rica)

"Impact fees for development tied to real impacts

"Environmental Assurance bonds to incorporate uncertainty about impacts (i.e. the Precautionary Polluter Pays Principle - 4P)

See:

Bernow, S., R. Costanza, H. Daly, et. Al.. 1998. Ecological tax reform. *BioScience* 48:193-196.

Costanza, R. and L. Cornwell. 1992. The 4P approach to dealing with scientific uncertainty.

*Environment* 34:12-20 42



REDEFINING PROFIT  
Natural+Social+Human+Built

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org



- Guiding Principles
- About Earth, Inc.
- Our Work
- Earth Shareholder Report
- Claim Your Share
- Earth Commons Collaborative
- Participate

## Earth Inc.

The Earth is our business and your business too. Most people have a basic understanding of how a business works. If you own part of the business, then you're entitled to a share of the profits. As an owner you'll want to take good care of the assets of the business and to plan for the future so your business doesn't collapse. You'll also want to maximize your profit, or in other words, the benefit you receive from the business. Imagine the Earth as a business and you're a shareholder. We're all shareholders. Future generations are entitled to a share too. How do we maximize the benefit every shareholder receives from the Earth? How do we maximize human wellbeing? Earth, Inc. helps answer this most important question.

### Board of Directors

- Robert Costanza
- Crea Lintilhac
- Shuang Liu
- Matt Sayre

### Advisory Board

- Peter Barnes
- Paul Hawken
- John Kassel
- David Orr



The amount of water impounded behind dams quadrupled since 1960, and three to six times as much water is held in reservoirs as in natural rivers.

## Earth News

### Protecting our common asset: The Earth

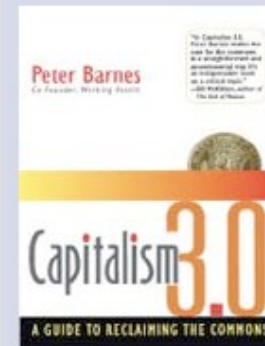
an article by Dr. Robert Costanza in the Rutland Herald. [More >](#)

### An Earth Atmospheric Trust: A proposal to stop global warming and end poverty

Internationally renowned experts call for the creation of the Earth Atmospheric Trust. [More >](#)

### Ecosystem Goods and Services Series: Valuation 101

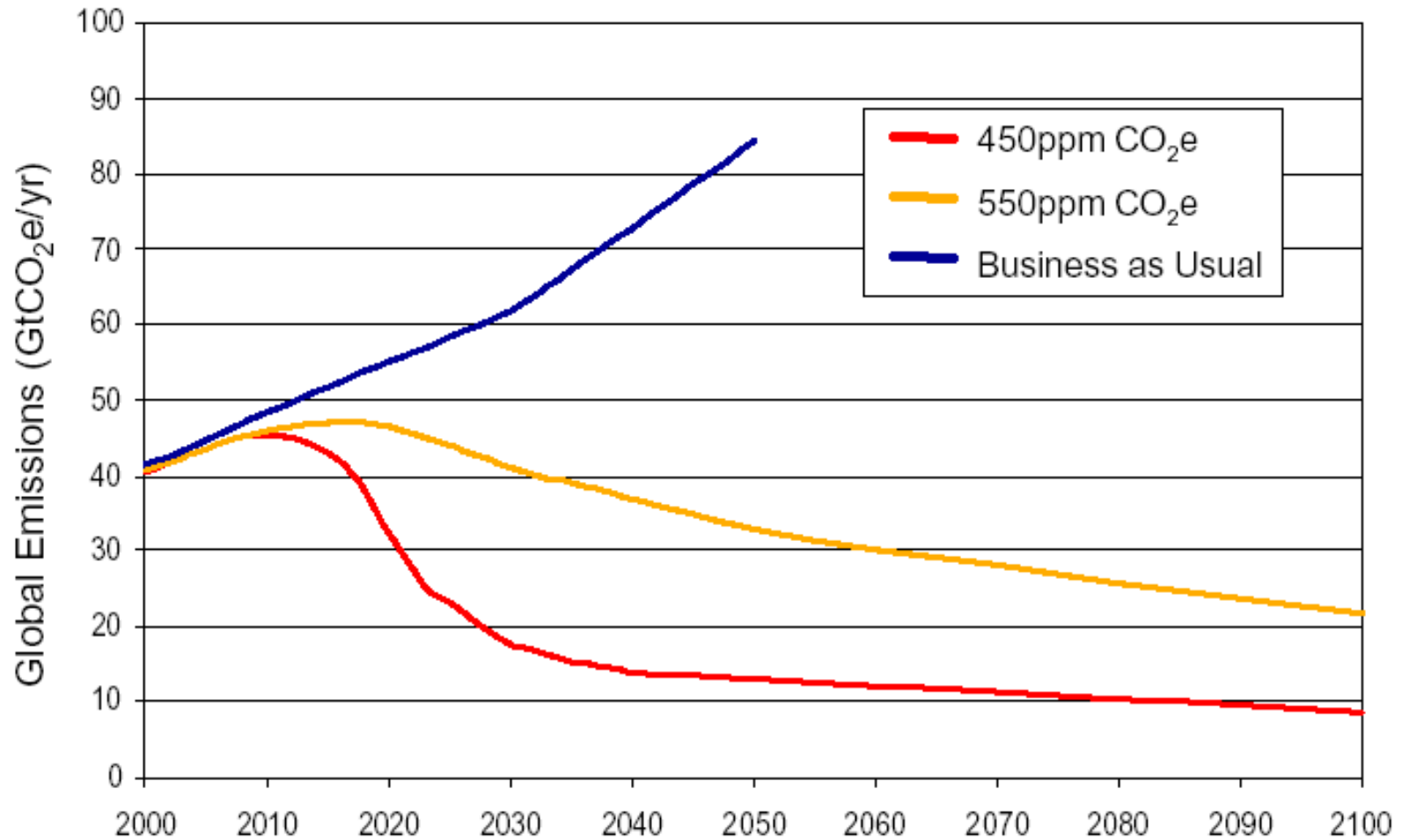
How much is a pristine lake worth? A clean atmosphere? An oil field? [More >](#)



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# Emissions Paths to Stabilisation



Source: Stern review on the economics of climate change, 2006

# **An Earth Atmospheric Trust:**

**A proposal to stop global warming *and* reduce poverty**  
([http://www.earthinc.org/earth\\_atmospheric\\_trust.php](http://www.earthinc.org/earth_atmospheric_trust.php))

- 1) **Set up a global cap and trade system** for greenhouse gas emissions all greenhouse gas emissions from all sources.
- 2) **Auction off all emission permits** and allow trading of permits
- 3) **Gradually reduce the cap to follow the 450 ppm target** (or better). The price of permits will go up and total revenues will increase as the cap is reduced.
- 4) **Deposit the revenues into a trust fund**, managed by trustees appointed with long terms and a mandate to protect the asset (the climate and atmosphere)
- 5) **Return a fraction of the revenues to everyone on earth on a per capita basis.** This amount will be insignificant to the rich, and much smaller than their per capita contribution to the fund, but will be enough to lift all the world's poor out of poverty.
- 6) **Use the remainder of the revenues to enhance and restore the asset.** They could be used to fund renewable energy projects, research and development on renewable energy, payments for ecosystem services such as carbon sequestration, etc.

## **Special features and cautions**

- 1) Do not allow revenues to go into the general fund of any government
- 2) Appoint trustees based on their qualifications and understanding of the purposes and details of the trust, not their political affiliations
- 3) Make all operations and transactions of the trust transparent by posting them open access on the internet
- 4) Make trustees accountable for their actions and decisions and subject to removal if they are not managing the trust for the benefit of the beneficiaries (all current and future people)

A large oil tanker ship is shown from a high-angle perspective, sailing on the ocean. The ship's deck is visible, with several large, reddish-brown rectangular tanks. The sky is filled with heavy, dark clouds, with a bright light source breaking through on the right side, creating a dramatic atmosphere. The ocean is dark and choppy.

# Thank You

Sign on to the Earth Atmospheric Trust at:  
[www.earthinc.org](http://www.earthinc.org)