Parliamentary Commissioner for Future Generations Roundtable

Towards a Low Carbon Economy in Hungary

Business Perspectives & Recommendations

Ecosystem Services in Climate Change Mitigation and Adaptation

Robert Costanza

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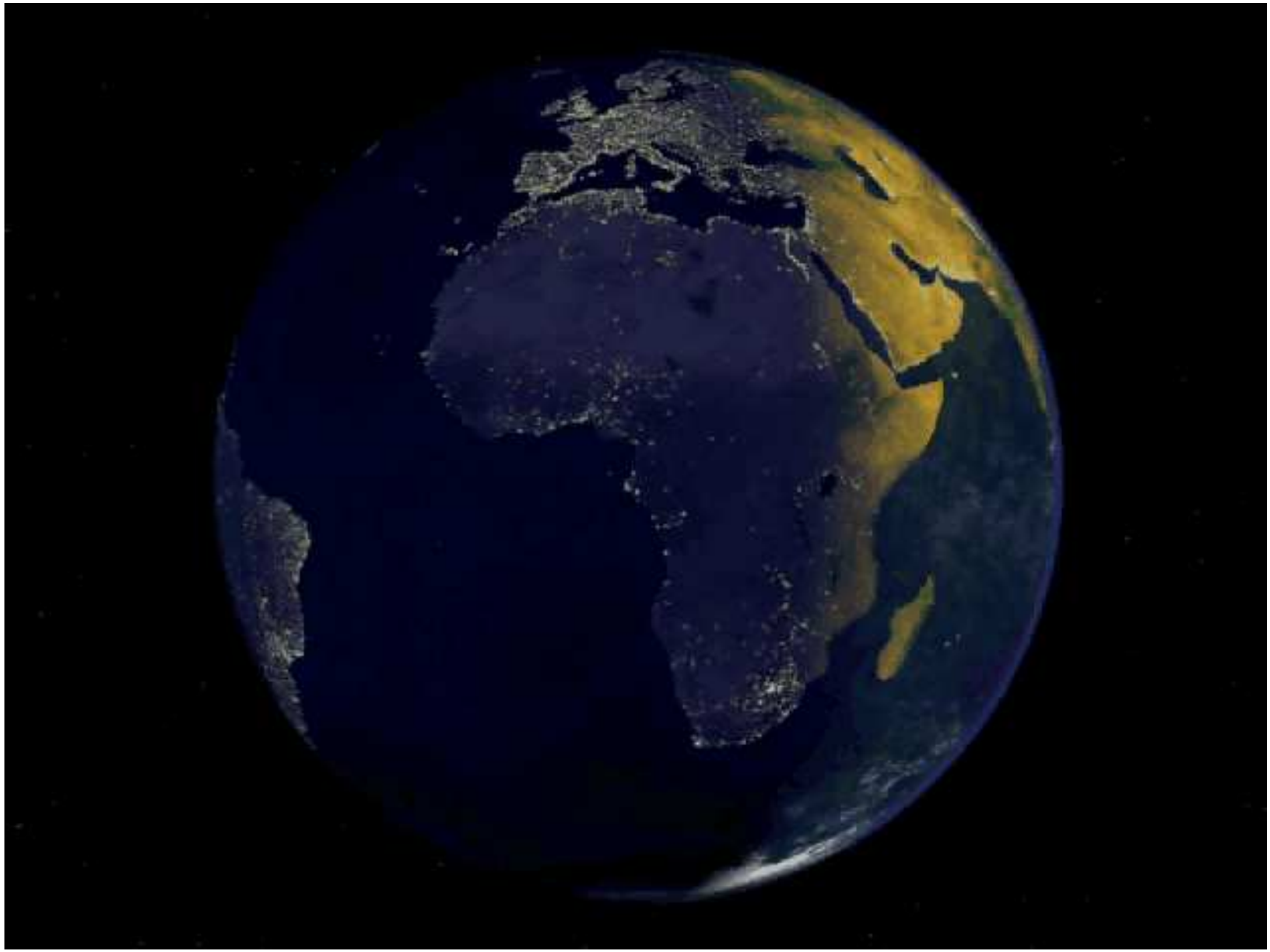
www.uvm.edu/giee

Full World in the Anthropocene
A “no analog” world.



Marc Imhoff

Biospheric Sciences Branch

NASA

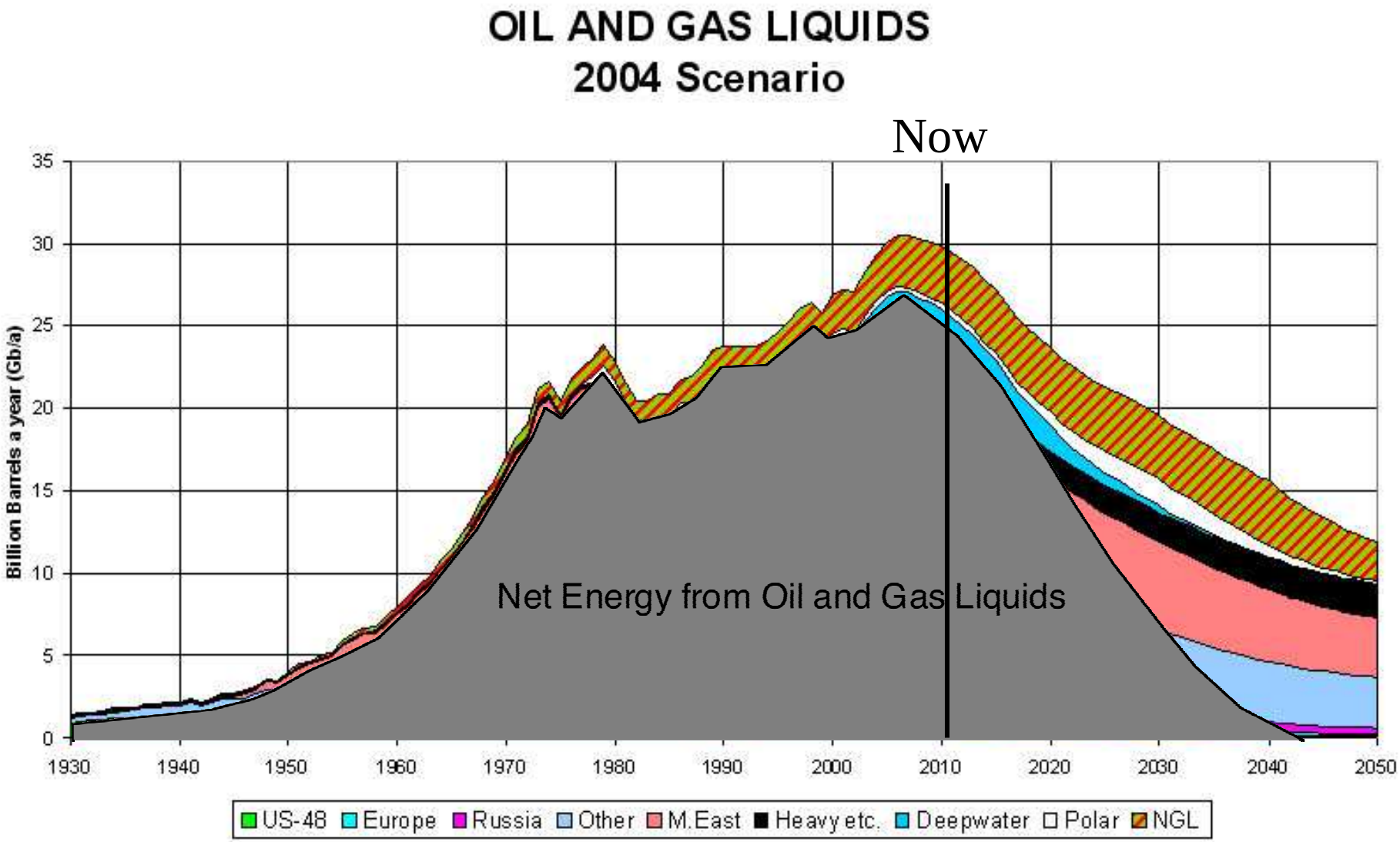
Practical Problem Solving Requires the *Integration* of:

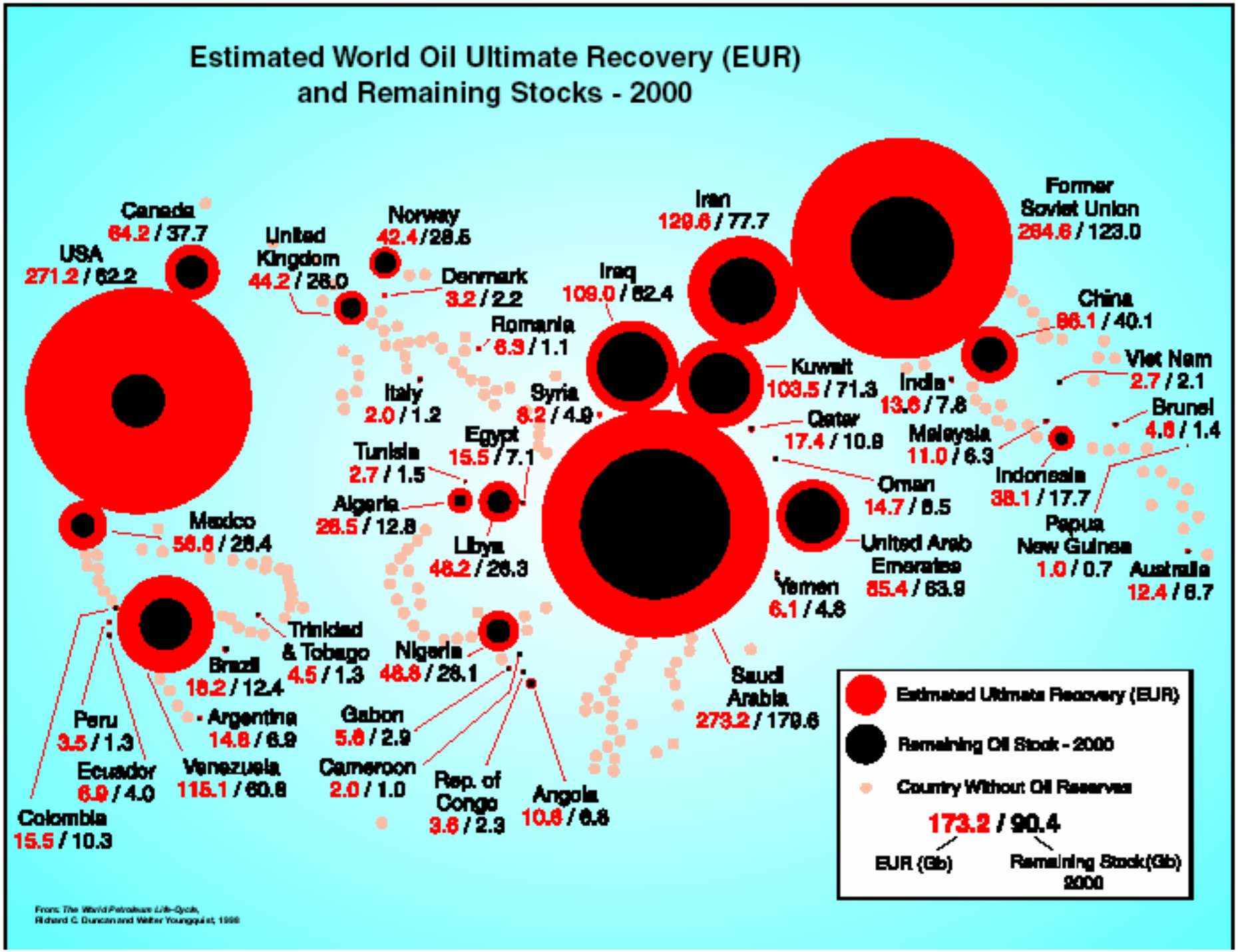
- Vision
  - a. How the world works
  - b. How we would like the world to be
- Tools and Analysis
  - appropriate to the vision
- Implementation
  - appropriate to the vision

“What if the crisis of 2008 represents something much more fundamental than a deep recession? What if it’s telling us that the whole growth model we created over the last 50 years is simply unsustainable economically and ecologically and that 2008 was when we hit the wall — when Mother Nature and the market both said: “No more.”

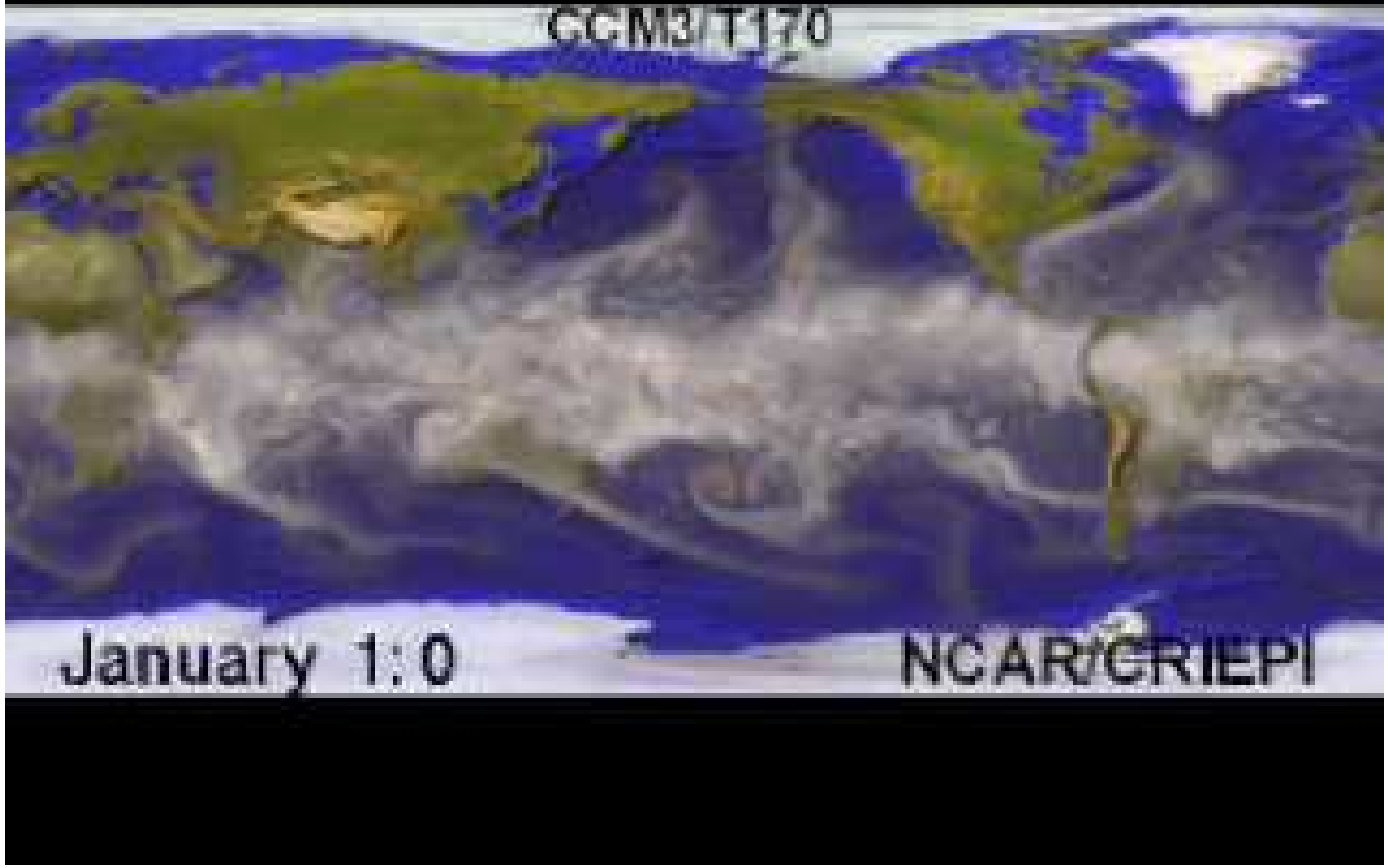
The Inflection Is Near?
By THOMAS L. FRIEDMAN
New York Times
Published: March 7, 2009

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

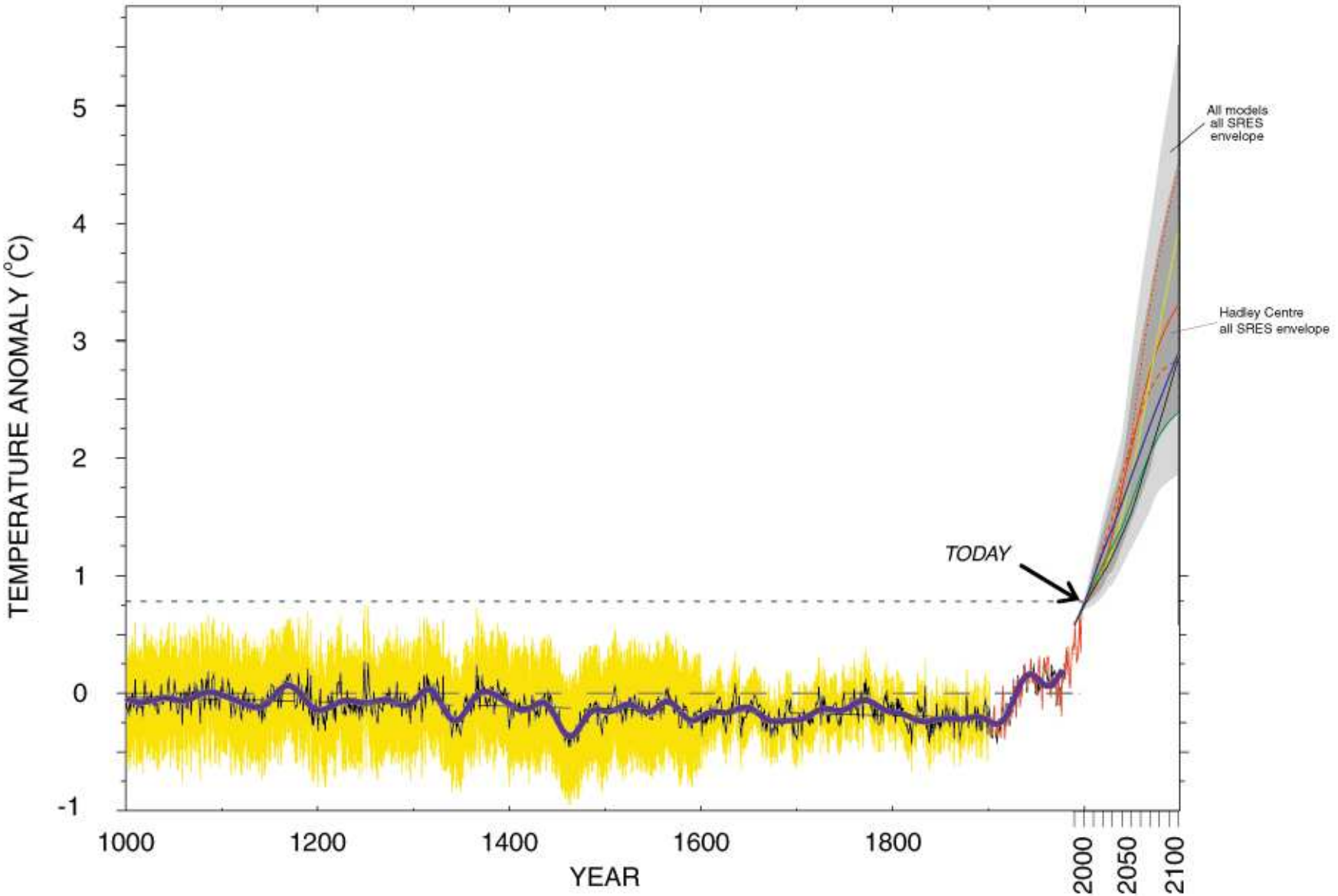


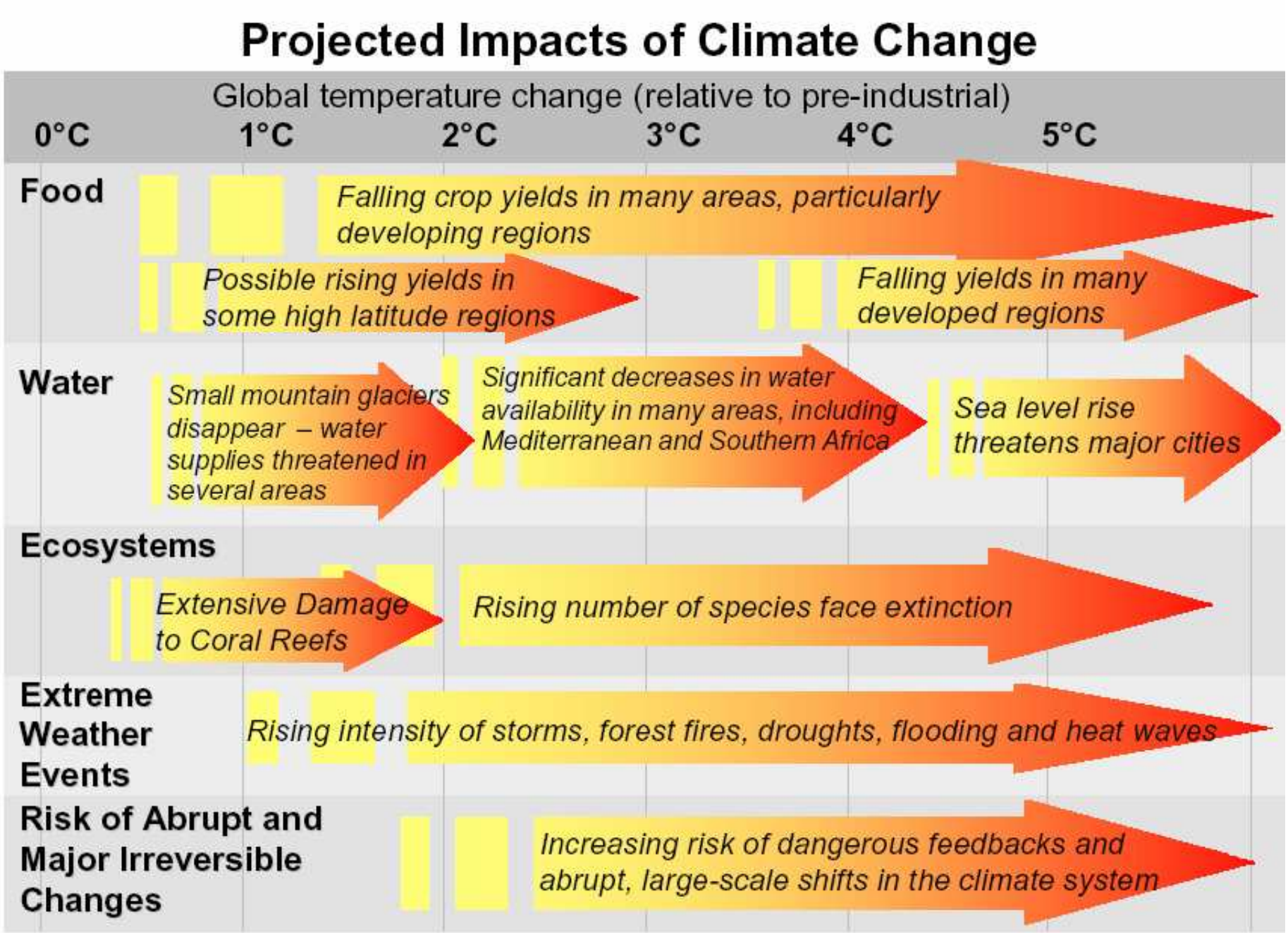

Estimated World Oil Ultimate Recovery (EUR)
and Remaining Stocks - 2000
Canada
64.2 / 37.7
USA
271.2 / 62.2
Mexico
56.6 / 26.4
Colombia
15.5 / 10.3
Peru
3.5 / 1.3
Ecuador
6.9 / 4.0
Venezuela
115.1 / 60.8
Brazil
18.2 / 12.4
Argentina
14.8 / 6.9
Trinidad
& Tobago
4.5 / 1.3
United
Kingdom
44.2 / 28.0
Norway
42.4 / 28.5
Denmark
3.2 / 2.2
Romania
6.3 / 1.1
Italy
2.0 / 1.2
Tunisia
2.7 / 1.5
Algeria
26.5 / 12.8
Egypt
15.5 / 7.1
Libya
48.2 / 26.3
Nigeria
48.8 / 26.1
Gabon
5.8 / 2.9
Cameroon
2.0 / 1.0
Rep. of
Congo
3.8 / 2.3
Angola
10.8 / 6.8
Iran
129.6 / 77.7
Iraq
109.0 / 82.4
Syria
8.2 / 4.9
Kuwait
103.5 / 71.3
Qatar
17.4 / 10.8
Oman
14.7 / 8.5
United Arab
Emirates
85.4 / 63.9
Yemen
6.1 / 4.8
Saudi
Arabia
273.2 / 179.6
Former
Soviet Union
284.6 / 123.0
China
86.1 / 40.1
India
13.6 / 7.8
Malaysia
11.0 / 6.3
Indonesia
38.1 / 17.7
Viet Nam
2.7 / 2.1
Brunei
4.8 / 1.4
Papua
New Guinea
1.0 / 0.7
Australia
12.4 / 8.7
Estimated Ultimate Recovery (EUR)
Remaining Oil Stock - 2000
Country Without Oil Reserves
173.2 / 90.4
EUR (Gb)
Remaining Stock(Gb)
2000
From The World Petroleum Life-Cycle,
Richard C. Duncan and Walter Youngquist, 1999

Atmosphere

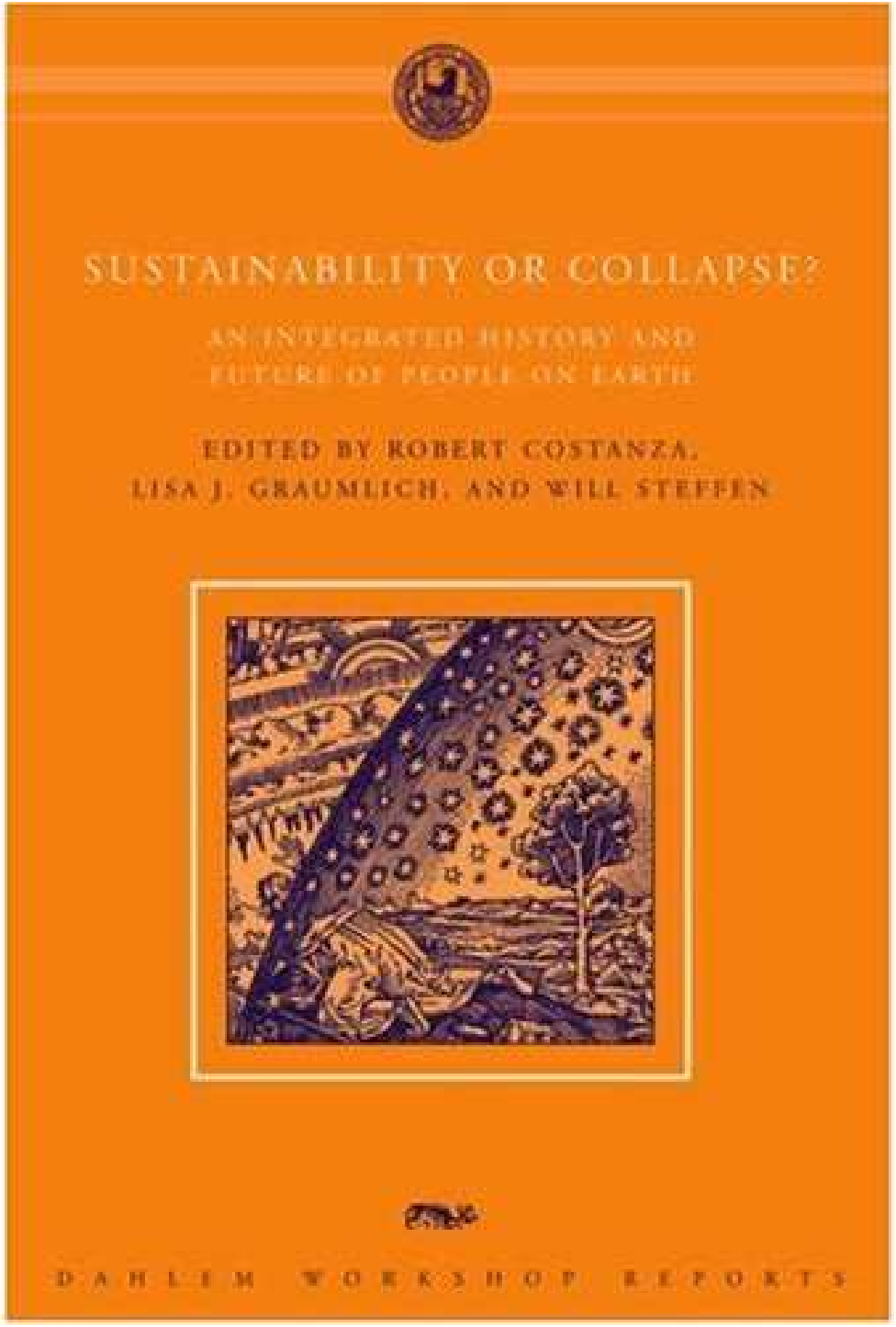


Temperature, past and future



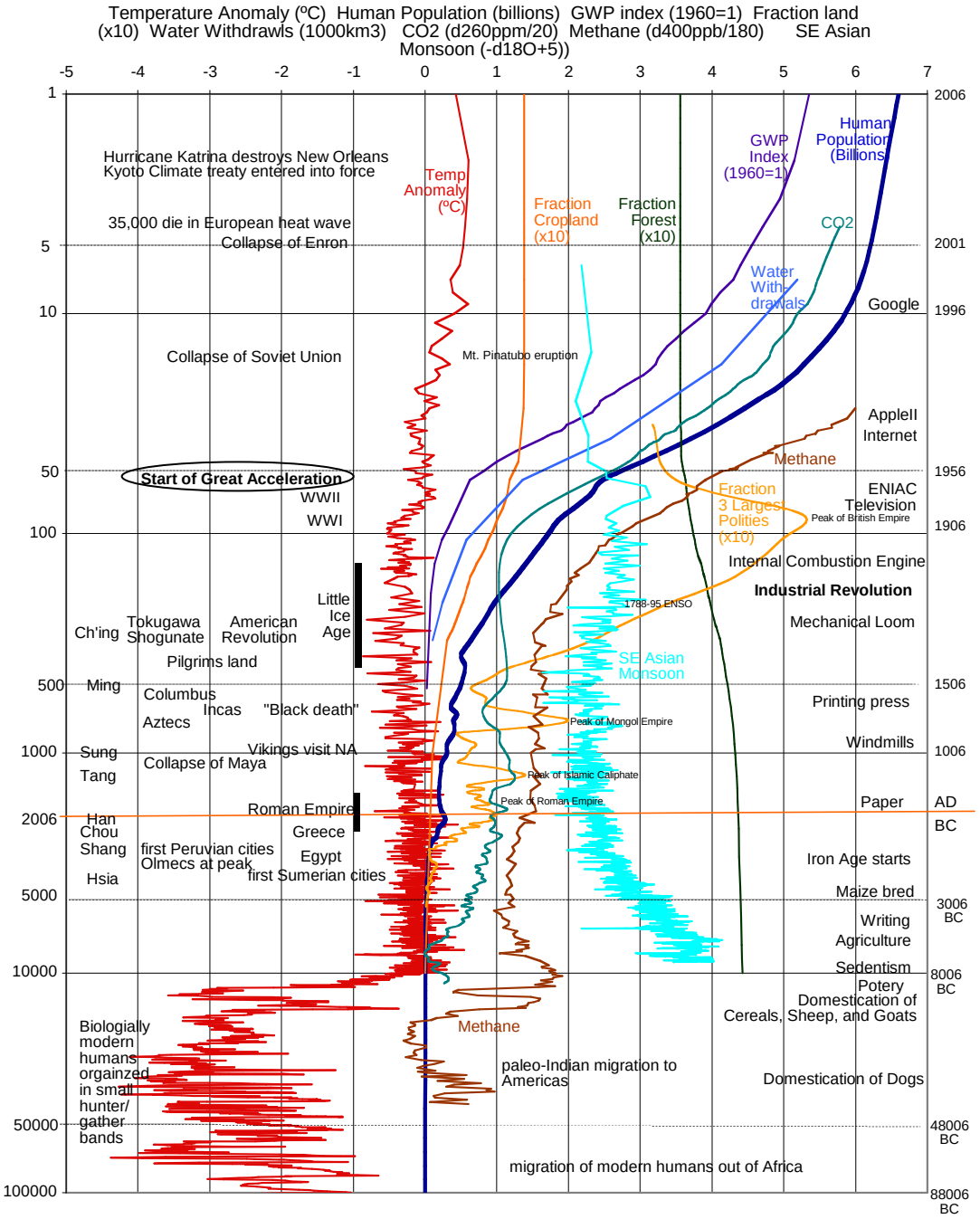


Source: Stern review on the economics of climate change, 2006



It has been said that if one fails to understand the past, one is doomed to repeat it.

If we can *really* understand the past, (by creating a science of the past) we can *create* a better, more sustainable and desirable future.

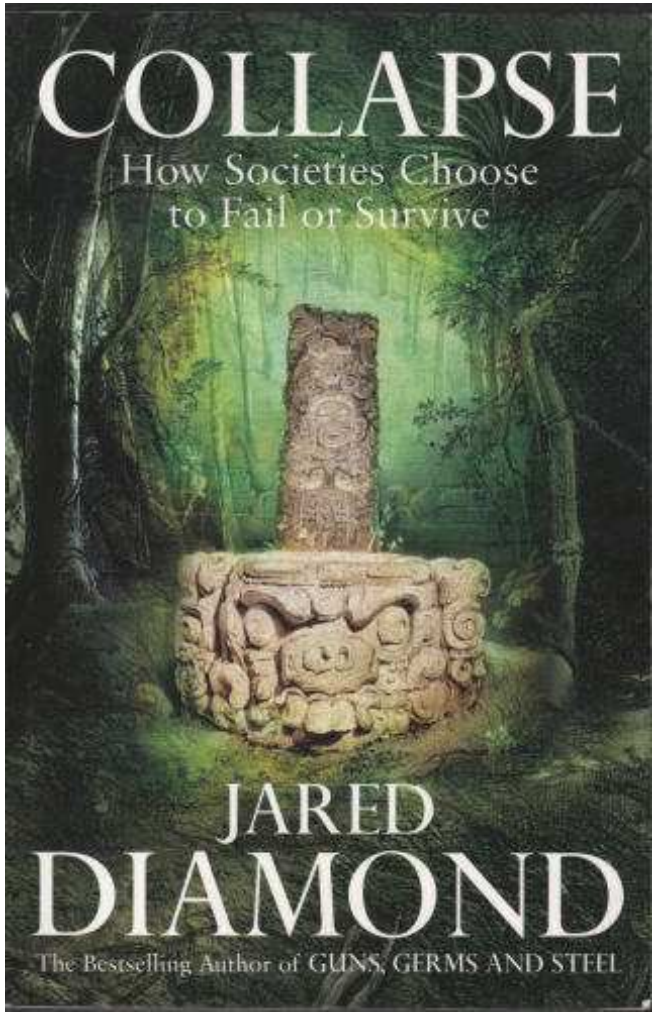


Integrated History and future Of People on Earth

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* 36:522-527

Jared Diamond identified what he considered to be the 12 most serious environmental problems facing past (and future) societies, problems that often have led to the collapse of historical societies:

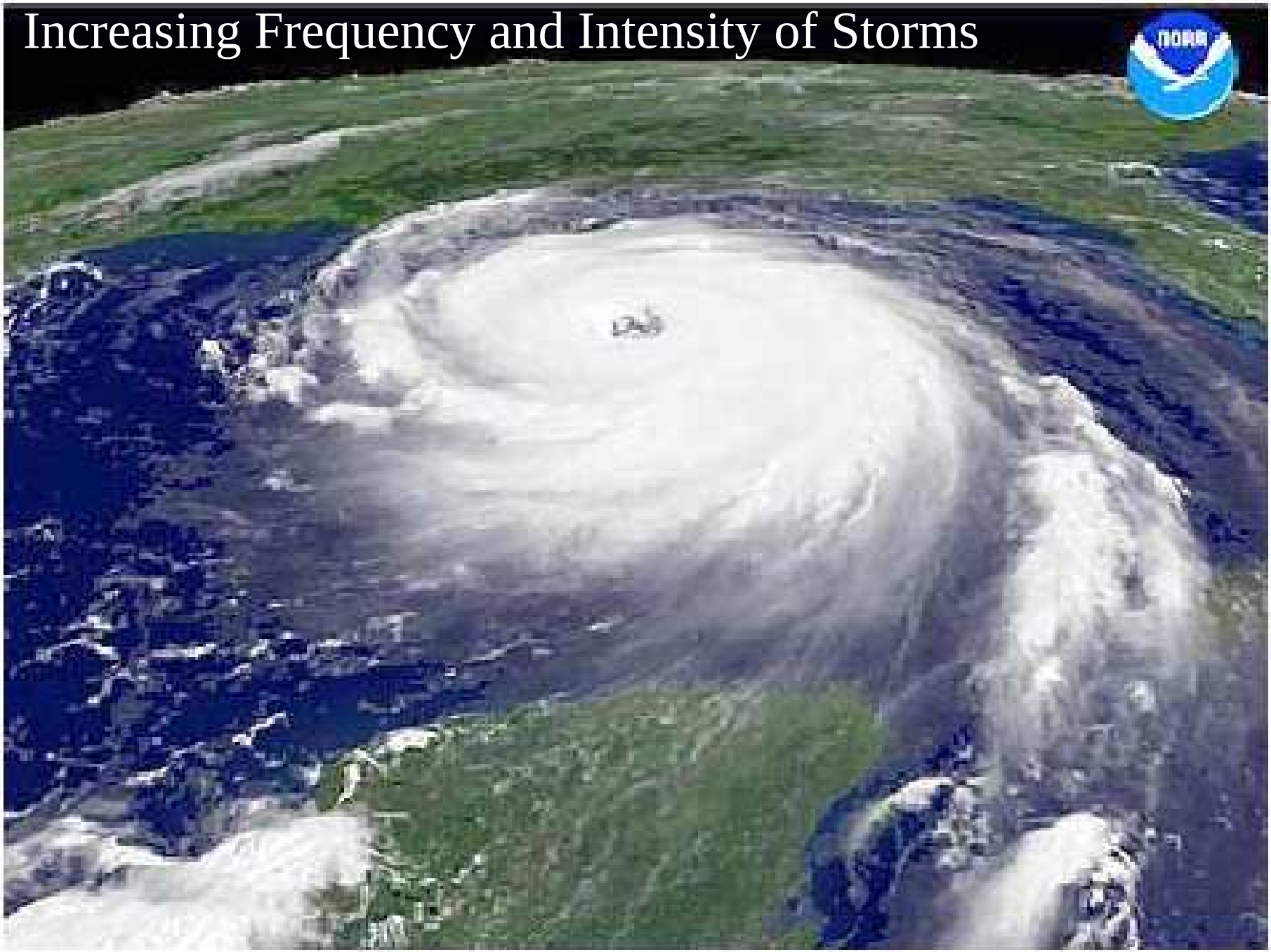
1) Loss of habitat and ecosystem services,
2) Overfishing,
3) Loss of biodiversity,
4) Soil erosion and degradation,
5) Energy limits,
6) Freshwater limits,
7) Photosynthetic capacity limits,
8) Toxic chemicals,
9) Alien species introductions,
10) Climate change,
11) Population growth, and
12) Human consumption levels.



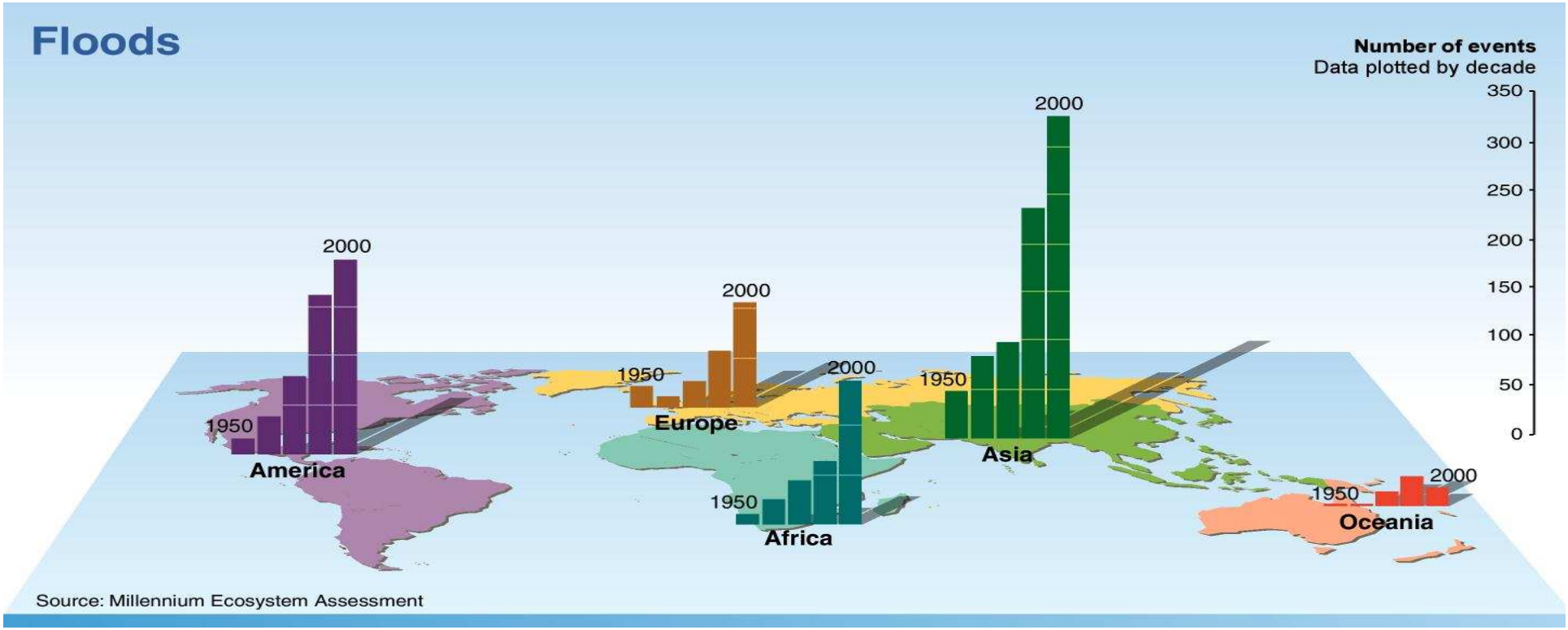
More importantly, Diamond, and several other authors before him emphasized that **the interplay of multiple factors is almost always more critical than any single factor.**

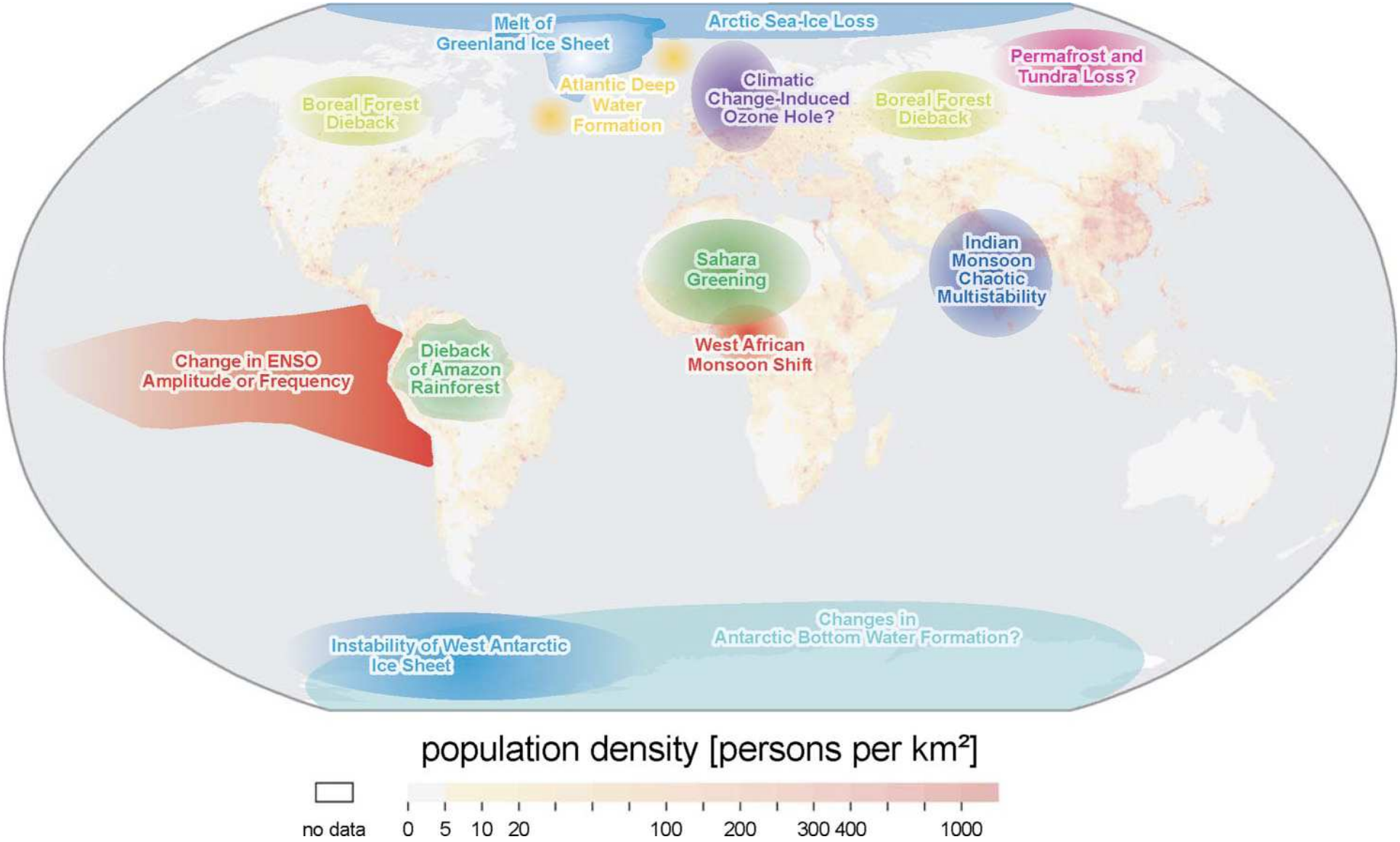
Systems that lose resilience are vulnerable to shocks from several sources.

Increasing Frequency and Intensity of Storms



Increasing number of flood events





Potential “tipping elements” in the climate system.

(from Lenton et al. 2008)

Rockström, J., W. Steffen, K. Noone, Å. Persson, F. S. Chapin, III, E. F. Lambin, T. M. Lenton, M. Scheffer, C. Folke, J. Schellnhuber, B. Nykvist, C. A. de Wit, T. Hughes, S. van der Leeuw, H. Rodhe, S. Sörlin, P. K. Snyder, R. Costanza, U. Svedin, M. Falkenmark, L. Karlberg, R. W. Corell, V. J. Fabry, J. Hansen, D. Liverman, K. Richardson, P. Crutzen, and J. Foley. 2009.

A safe operating space for humanity. *Nature* 461:472-475

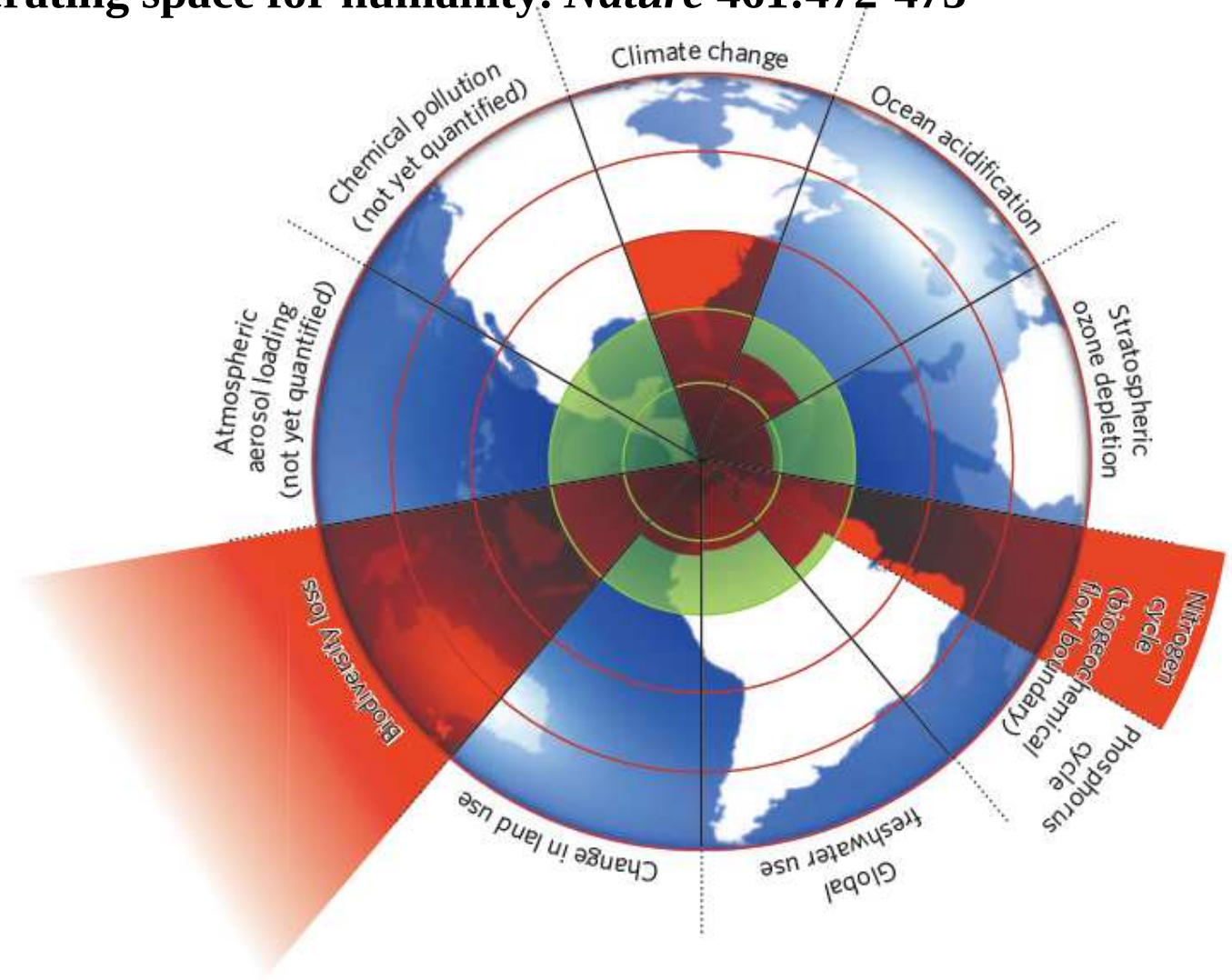
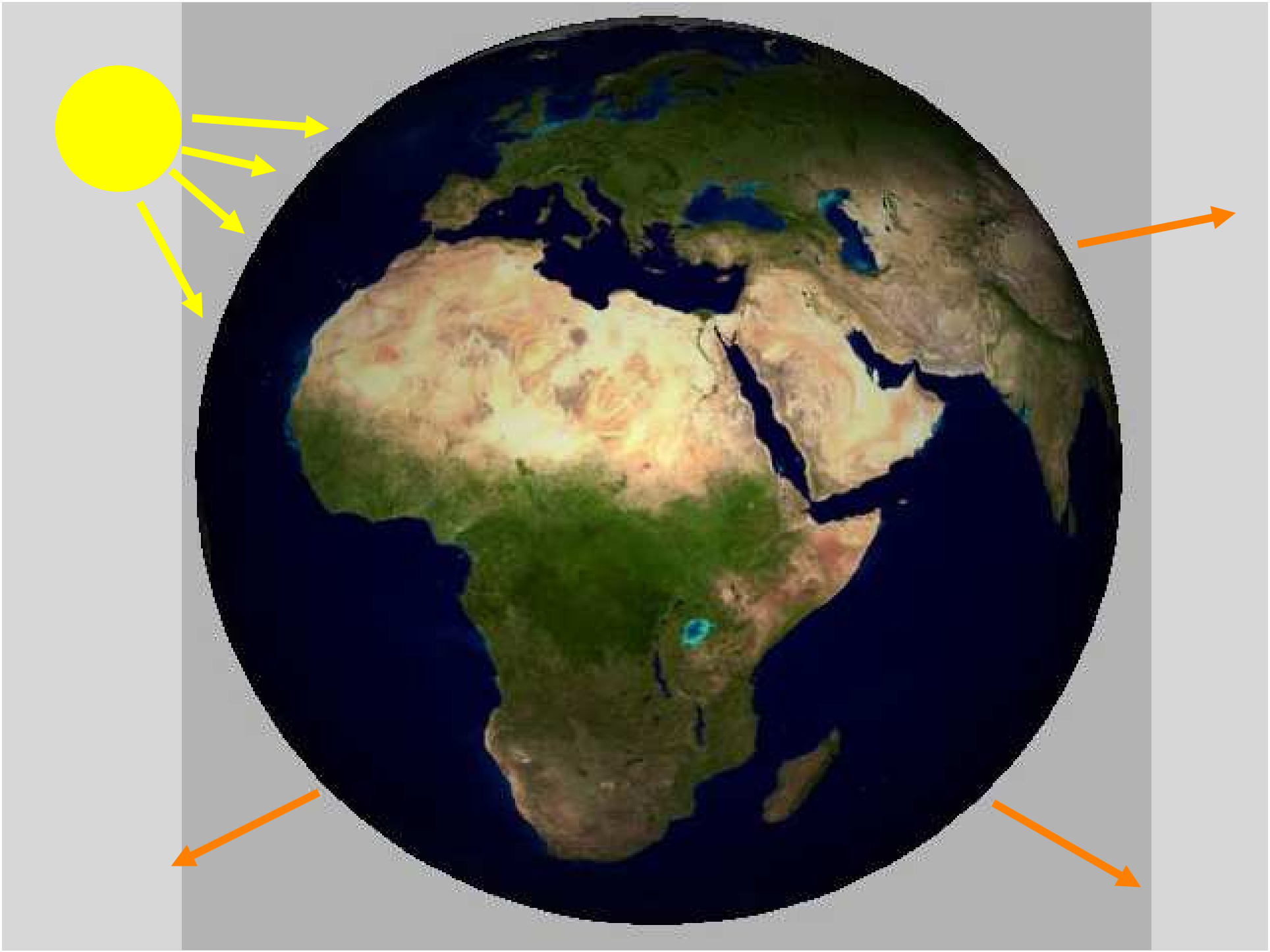


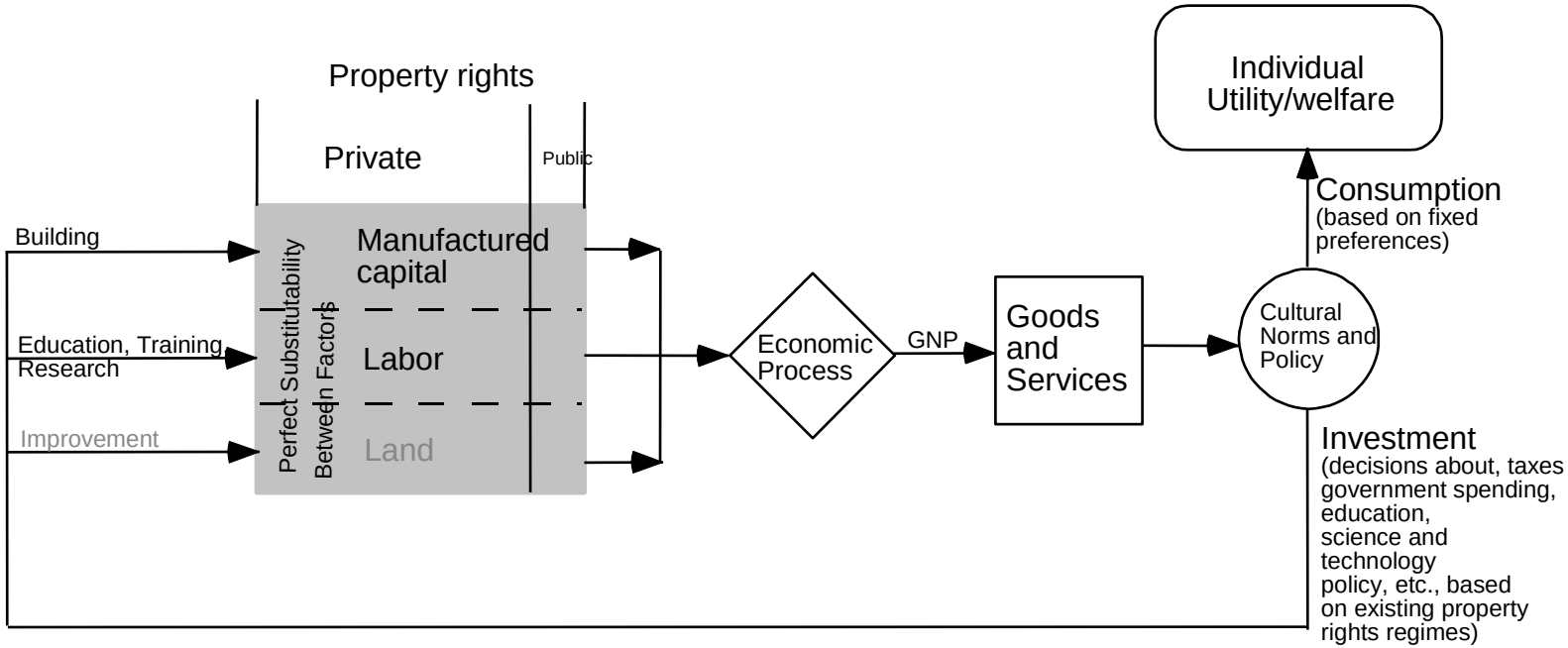
Figure 1 | Beyond the boundary. The inner green shading represents the proposed safe operating space for nine planetary systems. The red wedges represent an estimate of the current position for each variable. The boundaries in three systems (rate of biodiversity loss, climate change and human interference with the nitrogen cycle), have already been exceeded.

In a full world context, what is “the economy” and what is it for?

Gund Institute for Ecological Economics University of Vermont

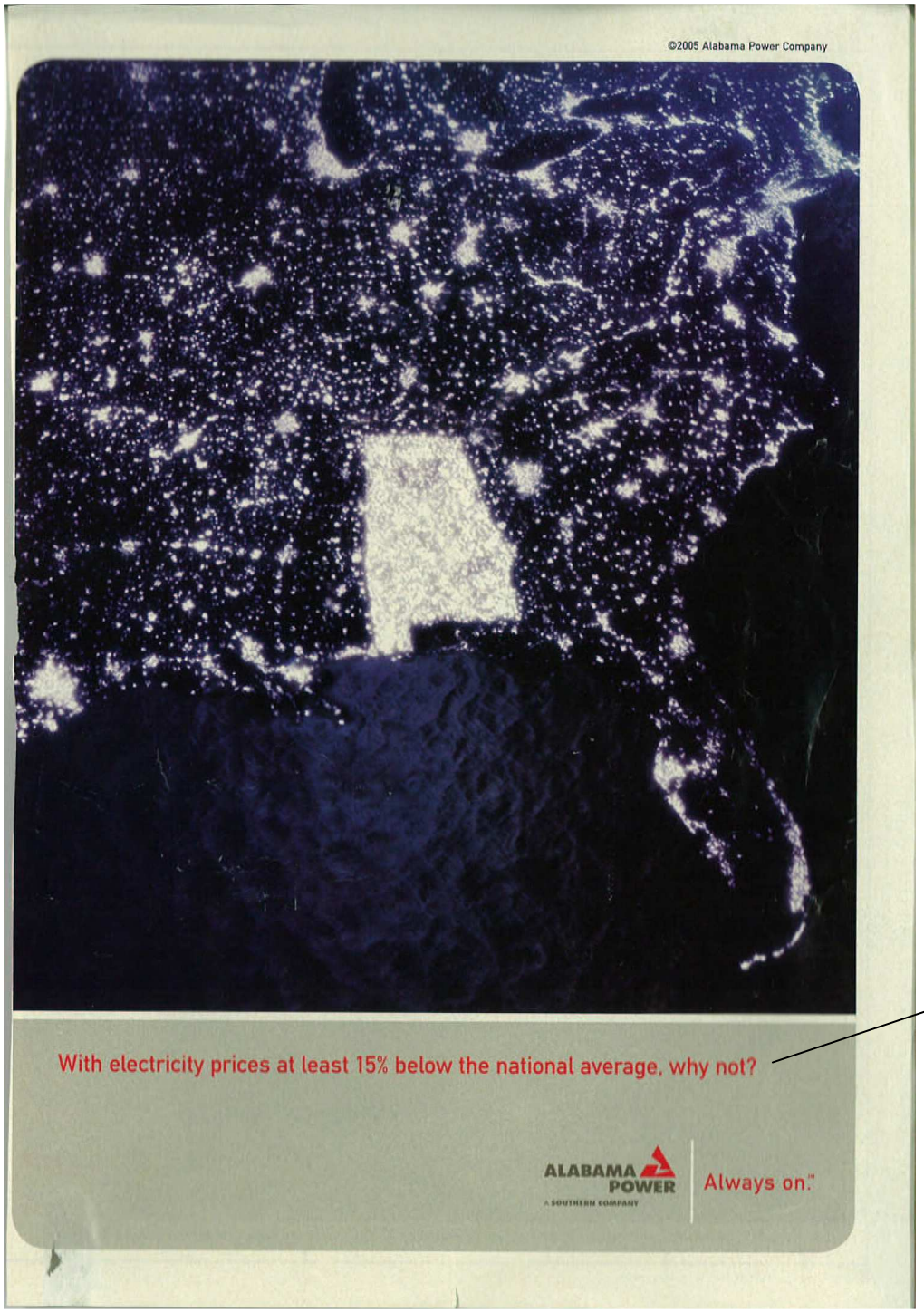


”Empty World" Model of the Economy



Basic premises:

- More is always better
- The economy can grow forever (scale is not an issue)
- Poverty can best be solved with more growth
- Nature is a side show
- Private property is always best



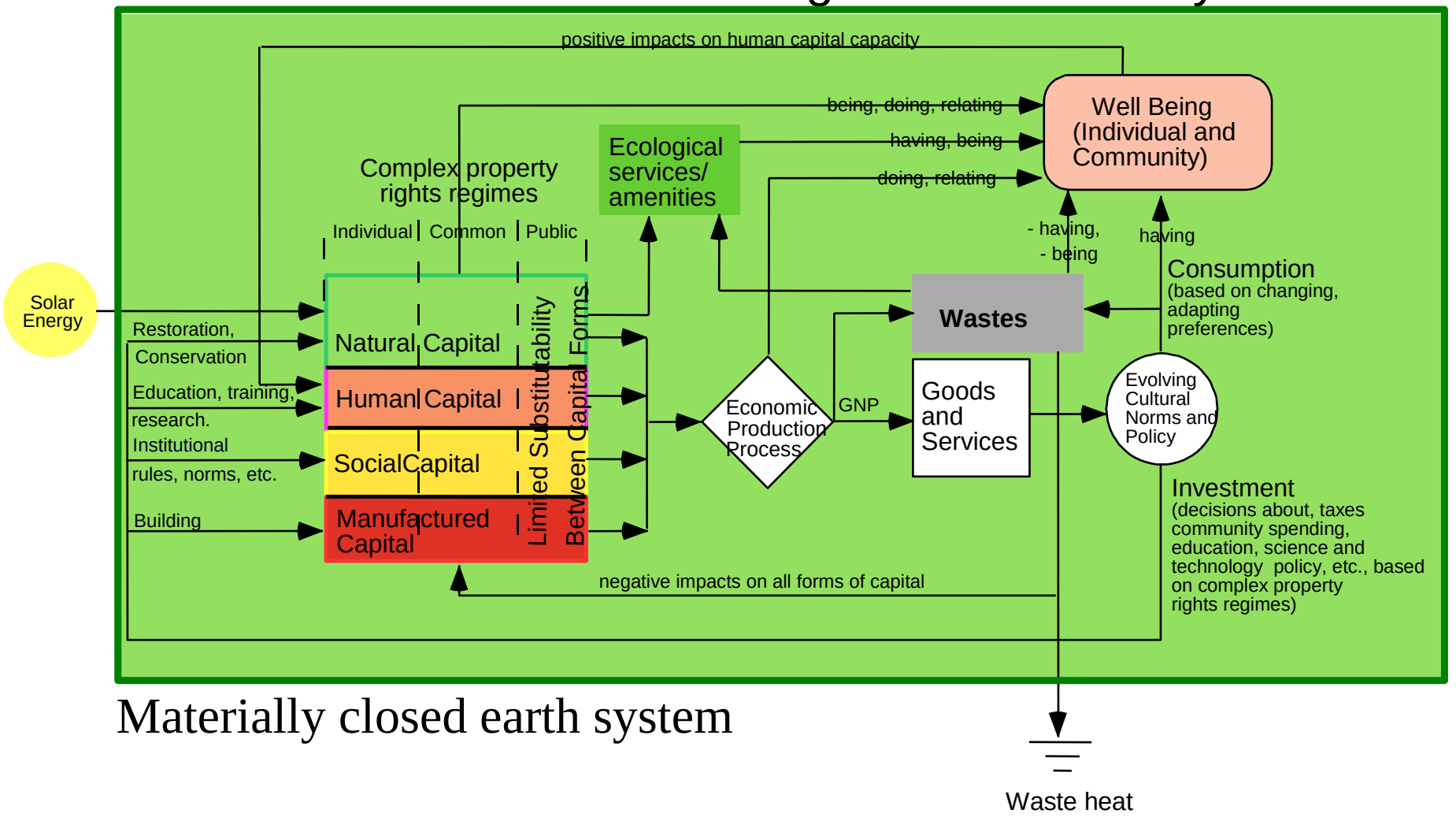
Empty World Energy Planning?

Alabama Power's motto: "Always on"

"With Electricity prices at least 15% below the national average, why not?

What will you wear to the apocalypse?

“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.

4 Capital Categories

Human capital is the physical bodies of individual humans, their health and education, and the information stored in their brains.

Social capital is the web of interpersonal connections, institutional arrangements, rules and norms that facilitate human interactions.

Built capital is the infrastructure (buildings, roads, houses, etc.) that make up the material structure of human society.

Natural capital is the land and the resources it contains, including ecological systems and services.

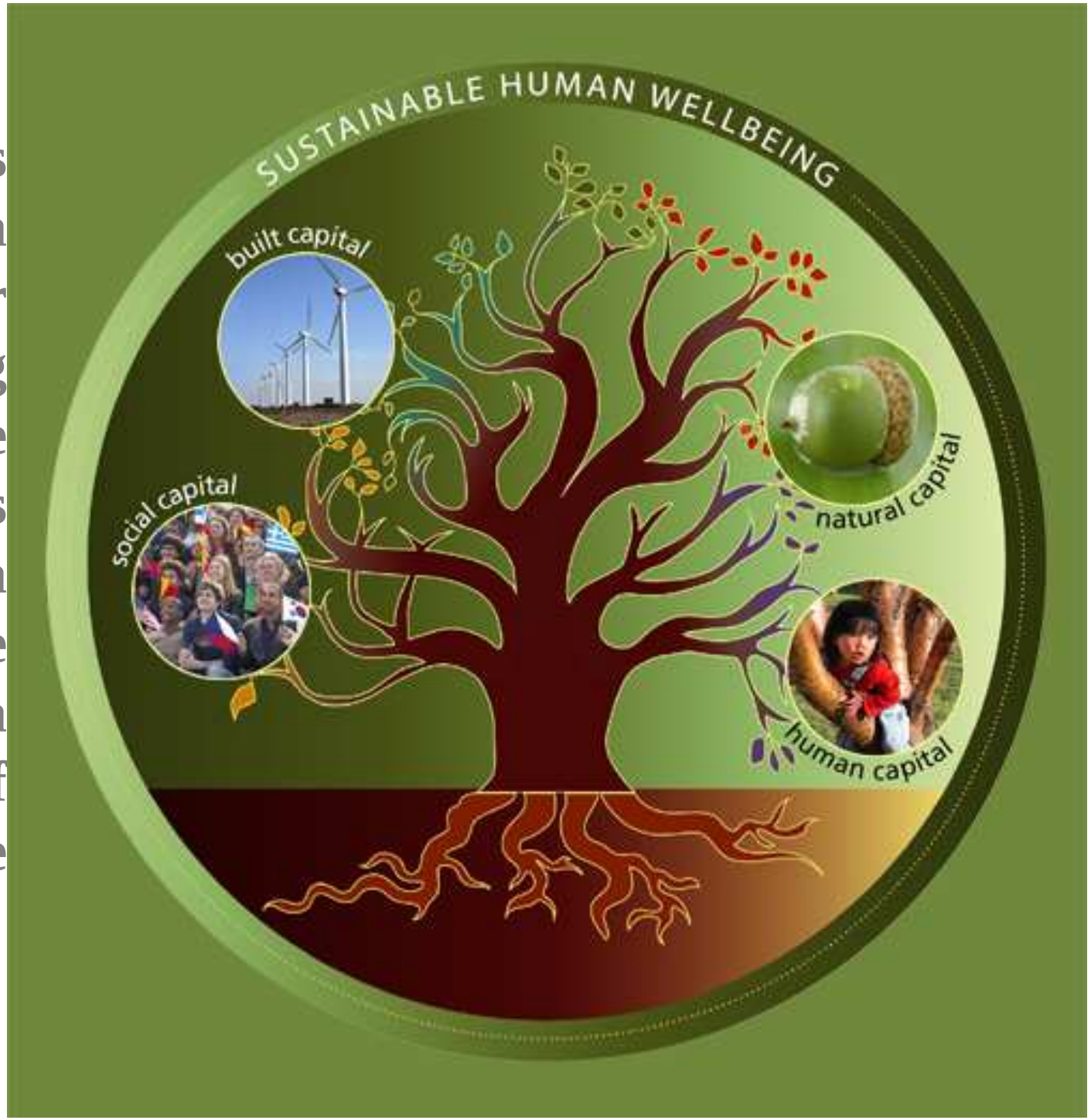
The Global Recession presents an opportunity *and a necessity* to change:

Worldviews Institutions and Technology

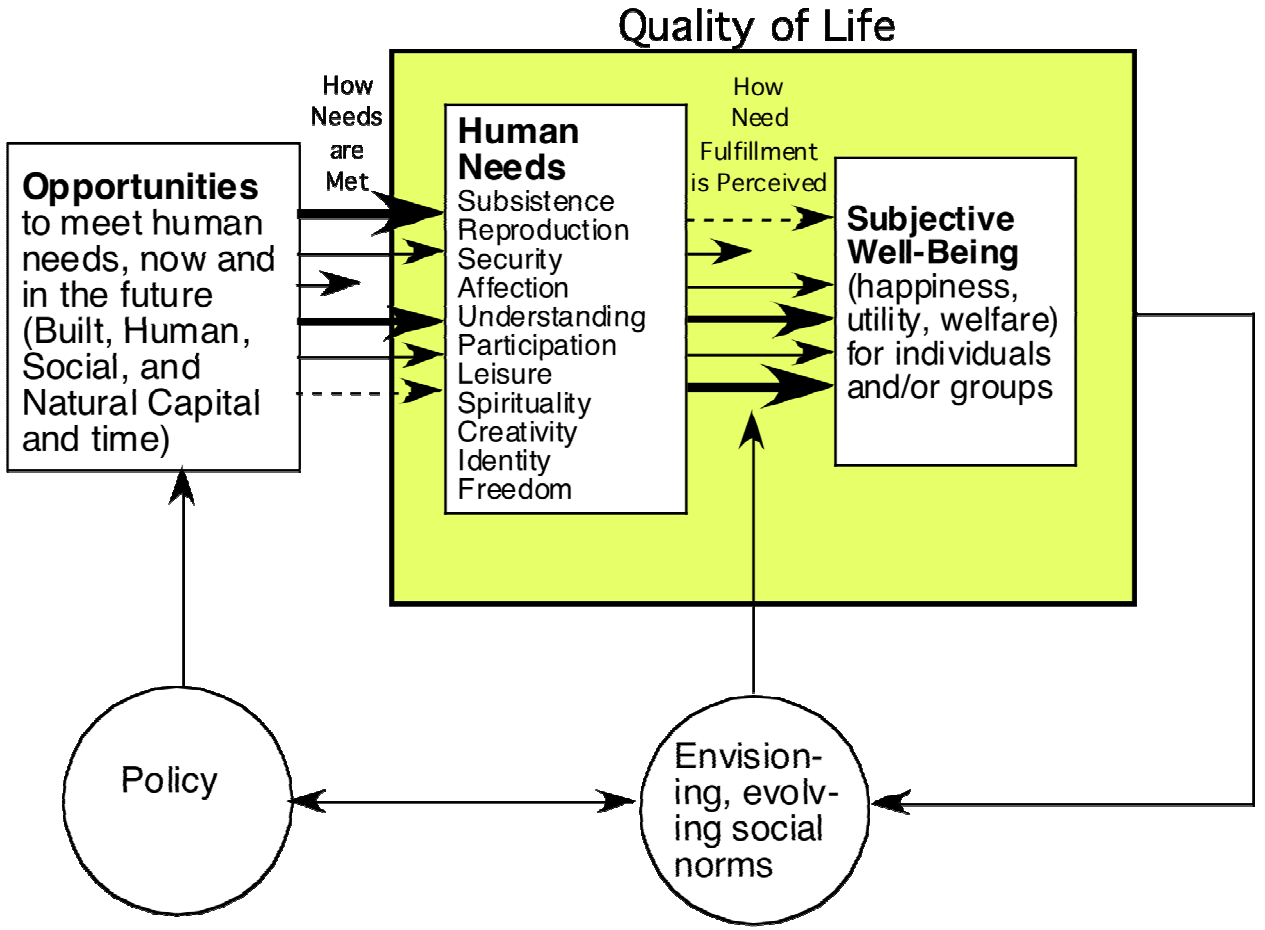
in an integrated way

From: Beddoe, R., R. Costanza, J. Farley, E. Garza, J. Kent, I. Kubiszewski, L. Martinez, T. McCowen, K. Murphy, N. Myers, Z. Ogden, K. Stapleton, and J. Woodward. 2009. Overcoming Systemic Roadblocks to Sustainability: the evolutionary redesign of worldviews, institutions and technologies. *Proceedings of the National Academy of Sciences* 106:2483-2489.

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



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).

Well-being vs. GDP

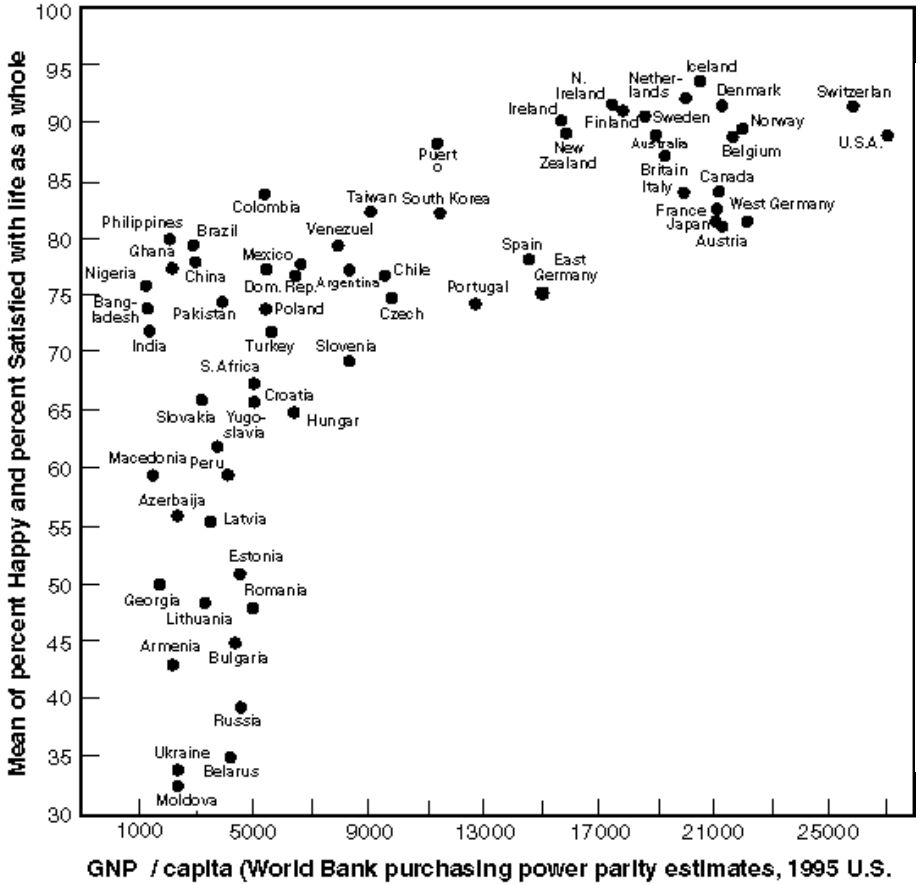
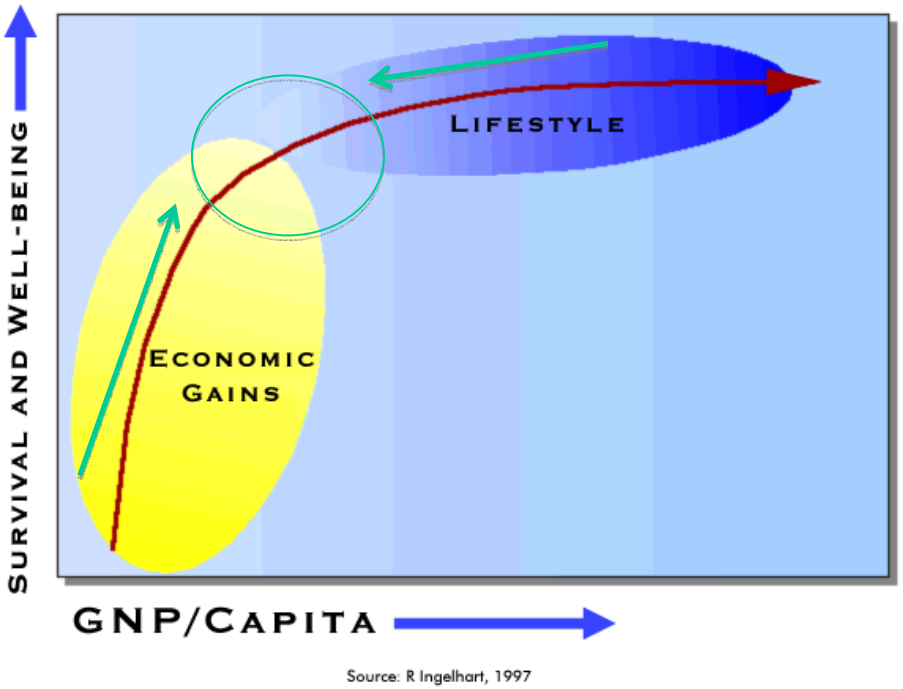


Figure 2. Subjective well-being by level of economic development.
Source: World Values Surveys; GNP/capita purchasing power estimates from World Bank, World Development Report, 1997.
R = .70 N = 65 p < .0000



Source: R Ingelhart, 1997

A range of goals for national accounting and their corresponding frameworks, measures, and valuation methods

Goal	Marketed	**Economic Income** Weak Sustainability	Strong Sustainability	**Economic Welfare**	**Human Welfare**
Basic Framework	value of marketed goods and services produced and consumed in an economy	1 + non-marketed goods and services consumption	2 + preserve essential natural capital	value of the wefare effects of income and other factors (including distribution, household work, loss of natural capital etc.)	assessment of the degree to which human needs are fulfilled
Non-environmentally adjusted measures	**GNP** (Gross National Product) **GDP** (Gross Domestic Product) **NNP** (Net National Product)			**MEW** (Measure of Economic Welfare)	**HDI** (Human Development Index)
Environmentally adjusted measures	**NNP'** (Net National Product including non-produced assetts)	**ENNP** (Environmental Net National Product) **SEEA** (System of Environmental Economic Accounts)	**SNI** (Sustainable National Income) **SEEA** (System of Environmental Economic Accounts)	**ISEW** (Index of Sustainable Economic Welfare)	**HNA** (Human Needs Assessment)
Appropriate Valuation Methods	Market values	1 + Willingness to Pay Based Values (see Table 2)	2 + Replacement Costs,+ Production Values	3 + Constructed Preferences	4 + Consensus Building Dialogue

From: Costanza, R., S. Farber, B. Castaneda and M. Grasso. 2001. Green national accounting: goals and methods. Pp. 262-282 in: Cleveland, C. J., D. I. Stern and R. Costanza (eds.) The economics of nature and the nature of economics. Edward Elgar Publishing, Cheltenham, England

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

Subtractions

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

Indices of ISEW and GPI for selected countries

From Jackson, T. and N. McBride. 2005. Measuring progress? European Environmental Agency

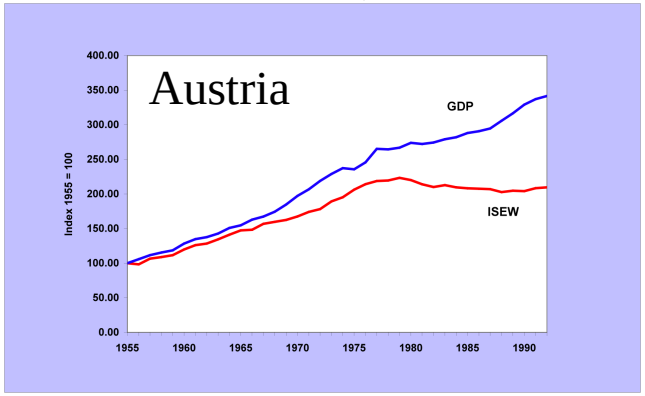


Figure 5: ISEW vs GDP per capita in Austria 1955-1992

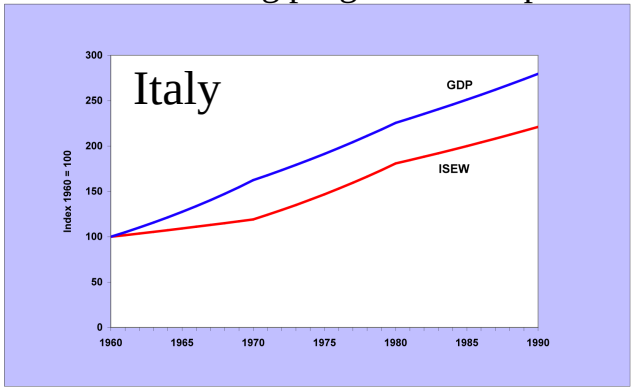


Figure 8: ISEW and GDP per capita in Italy: 1960 to 1990

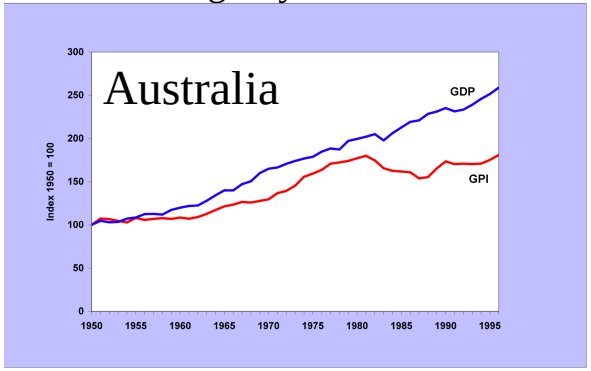


Figure 4: GPI and GDP per capita in Australia 1950-1996

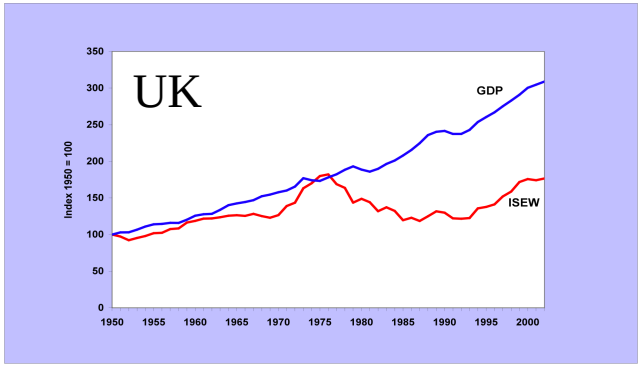


Figure 13: MDP and GDP per capita in the UK 1950-2002

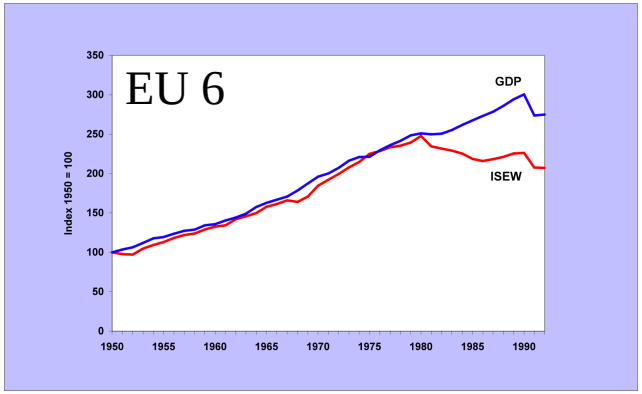


Figure 15: Illustrative Average ISEW and GDP/cap for EU 6 1950-1992

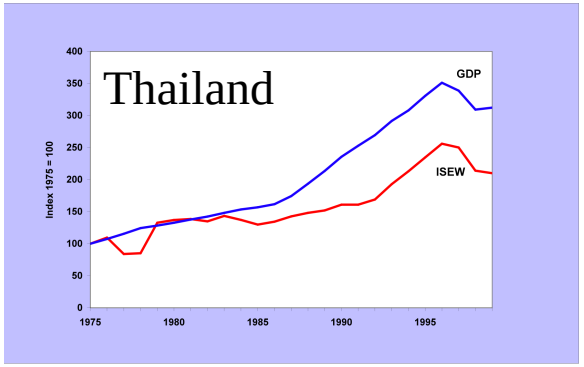


Figure 12: ISEW and GDP per capita in Thailand 1975-1999

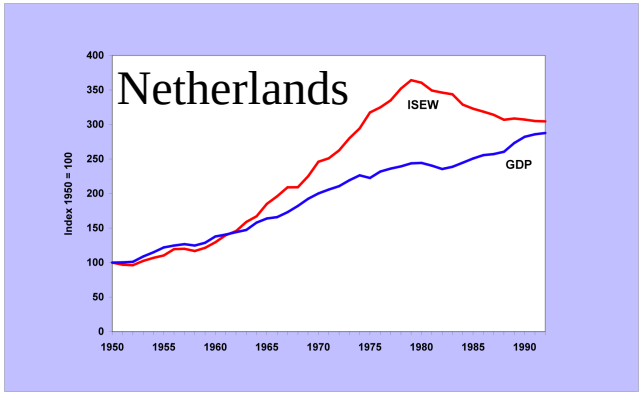


Figure 9: ISEW and GDP per capita in the Netherlands 1950-1992

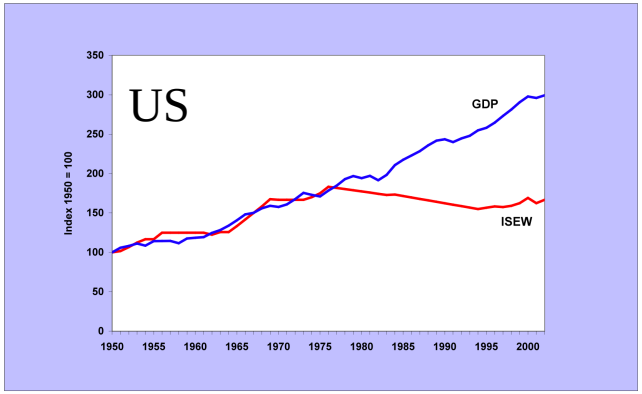


Figure 14: GPI and GDP per capita in the US 1950-2000

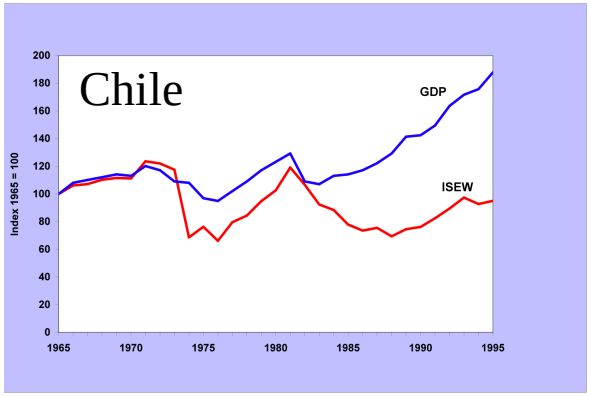
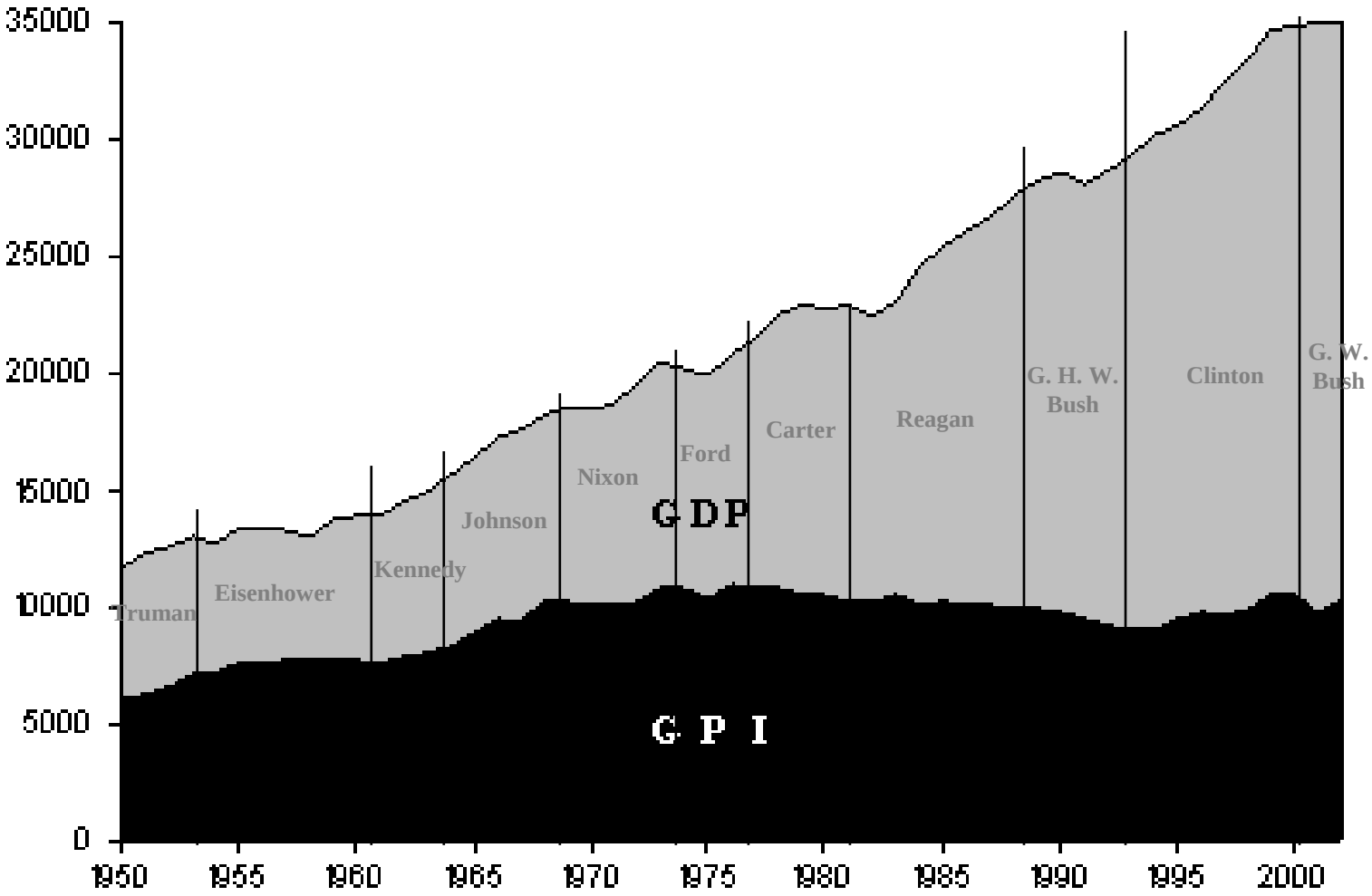
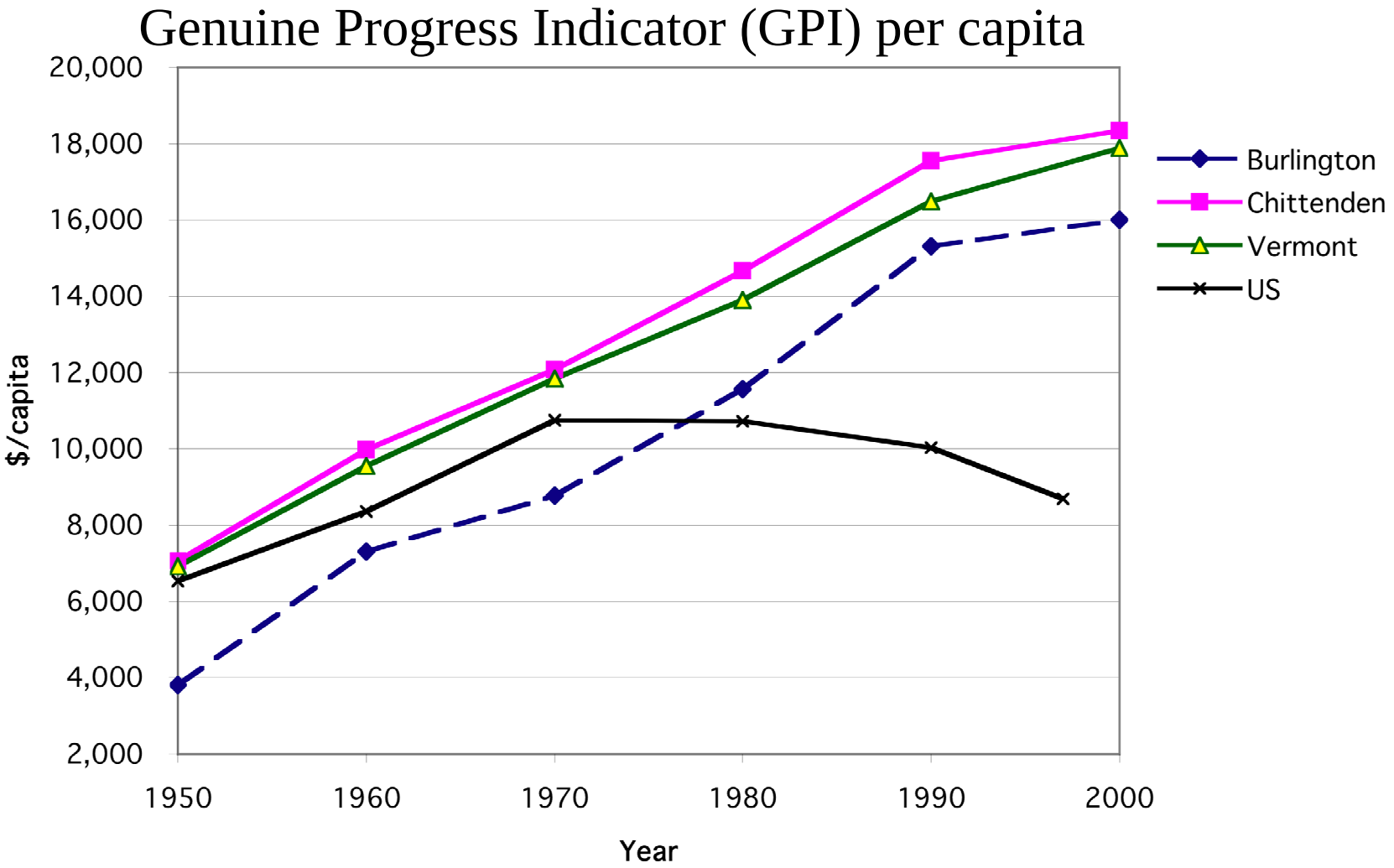


Figure 6: ISEW and GDP per capita in Chile 1965-1995

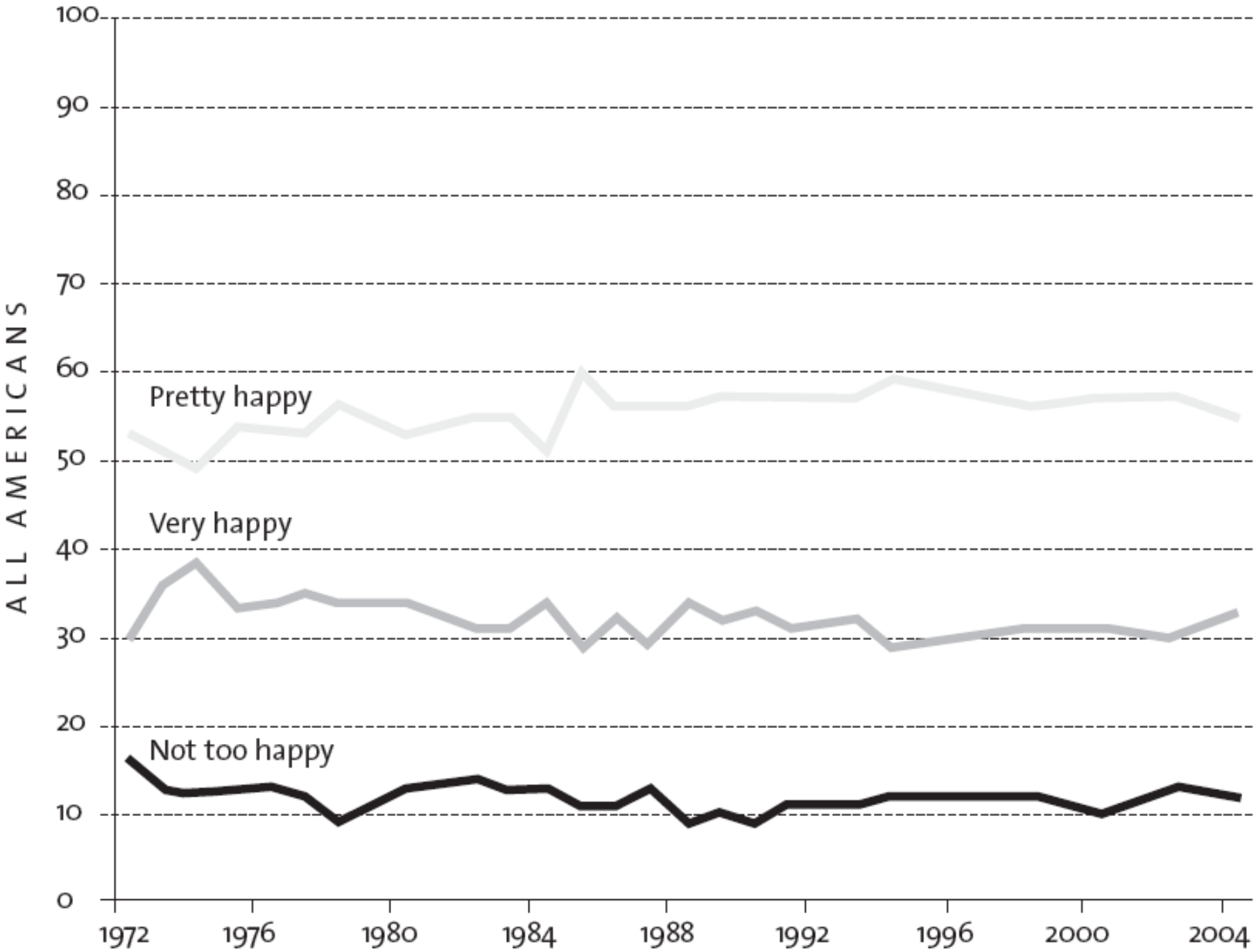


Gross Production vs. Genuine Progress for the US, 1950 to 2002

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



From: Costanza, R. J. Erickson, K. Fligger, A. Adams, C. Adams, B. Altschuler, S. Balter, B. Fisher, J. Hike, J. Kelly, T. Kerr, M. McCauley, K. Montone, M. Rauch, K. Schmiedeskamp, D. Saxton, L. Sparacino, W. Tusinski, and L. Williams. 2004. Estimates of the Genuine Progress Indicator (GPI) for Vermont, Chittenden County, and Burlington, from 1950 to 2000. *Ecological Economics* 51: 139-155


ALL AMERICANS
100
90
80
70
60
50
40
30
20
10
0
Pretty happy
Very happy
Not too happy
1972
1976
1980
1984
1988
1992
1996
2000
2004

Bottom Line: Growth in material consumption (GDP) is not sustainable AND it does not necessarily bring happiness

Differences between the current, empty world model and the full world model

From: Costanza, R. 2008. Stewardship for a "full" world. *Current History* 107:30-35

	Current Development Model: the "Washington Consensus"	**Sustainable and Desirable Development Model:** an emerging "Green Consensus"
Primary policy goal	**More:** economic growth in the conventional sense, as measured by GDP. More is always better.	**Better**: Focus must shift from merely growth to "development" in the real sense of improvement in quality of life
Primary measure of progress	GDP	GPI (or similar)
Scale/carrying capacity	Not an issue since markets are assumed to be able to overcome any resource limits via new technology	A primary concern as a determinant of ecological sustainability. Real limits exist
Distribution/poverty	Lip service, but relegated to "politics" and a "trickle down" policy: a rising tide lifts all boats	A primary concern since it directly affects quality of life and social capital and is often exacerbated by growth
Economic efficiency/allocation	The primary concern, but generally including only marketed goods and services (GDP) and market institutions	A primary concern, but including both market and non-market goods and services – natural and social capital.
Property rights	Emphasis on private property and conventional markets	Emphasis on a balance of private, state, and common property rights regimes appropriate to the nature and scale of the system, and a linking of rights with responsibilities
Role of Government	To be minimized and replaced with private and market institutions	A central role, including new functions as referee, facilitator and broker in a new suite of common asset institutions
Principles of Governance	*Laissez faire* market capitalism	Lisbon principles of sustainable governance

The Commons

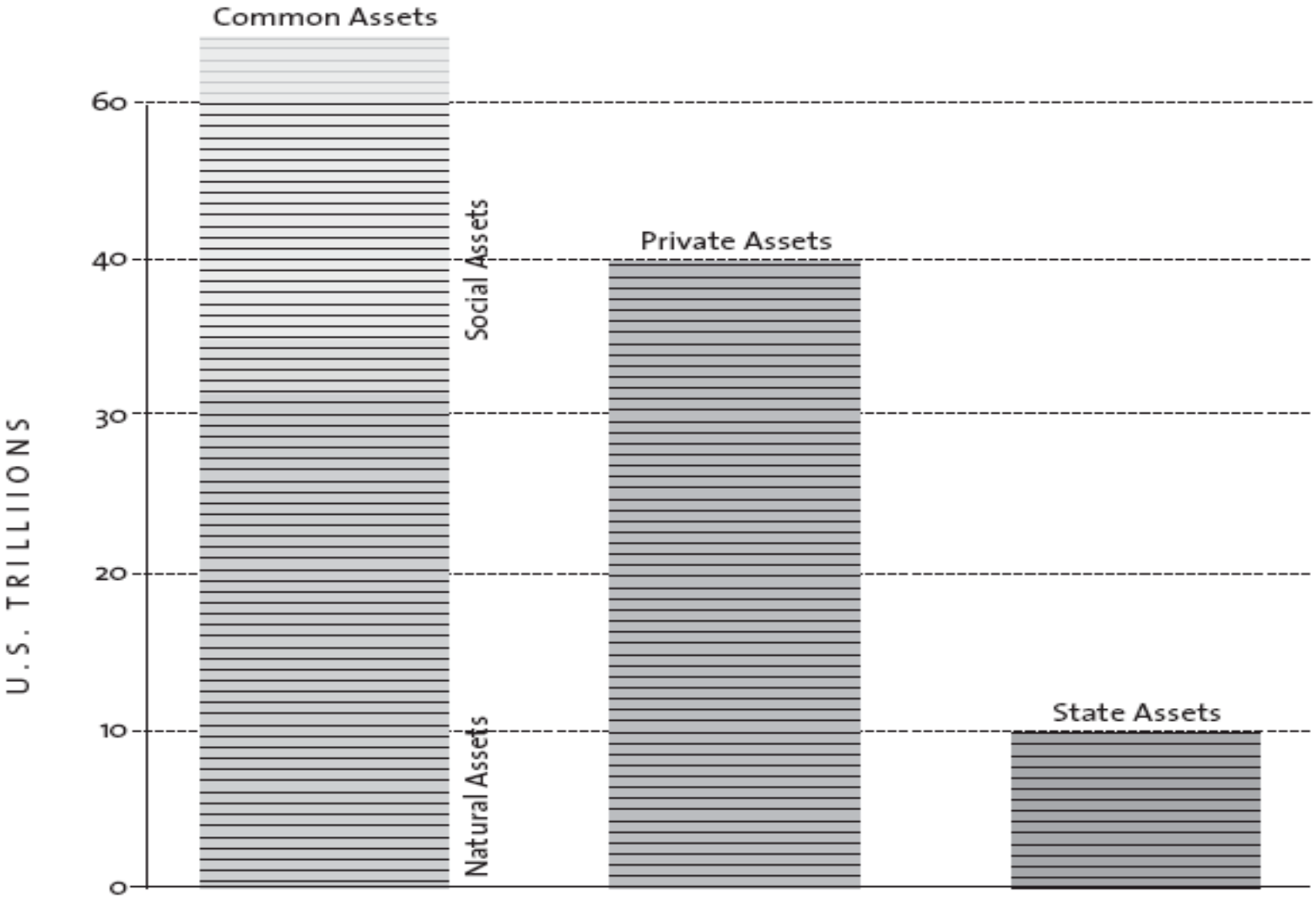
“ refers to all the gifts we inherit or create together. This notion of the commons designates a set of assets that have two characteristics:

they’re all **gifts**, and
they’re all **shared**.

A gift is something we receive, as opposed to something we earn.
A shared gift is one we receive as members of a community, as opposed to individually.
Examples of such gifts include air, water, ecosystems, languages, music, holidays, money, law, mathematics, parks, the Internet, and much more”.

Peter Barnes, *Capitalism 3.0: a guide to reclaiming the commons*

Figure 5.1
APPROXIMATE VALUE OF COMMON, PRIVATE, AND STATE ASSETS, 2001 ($ TRILLIONS)



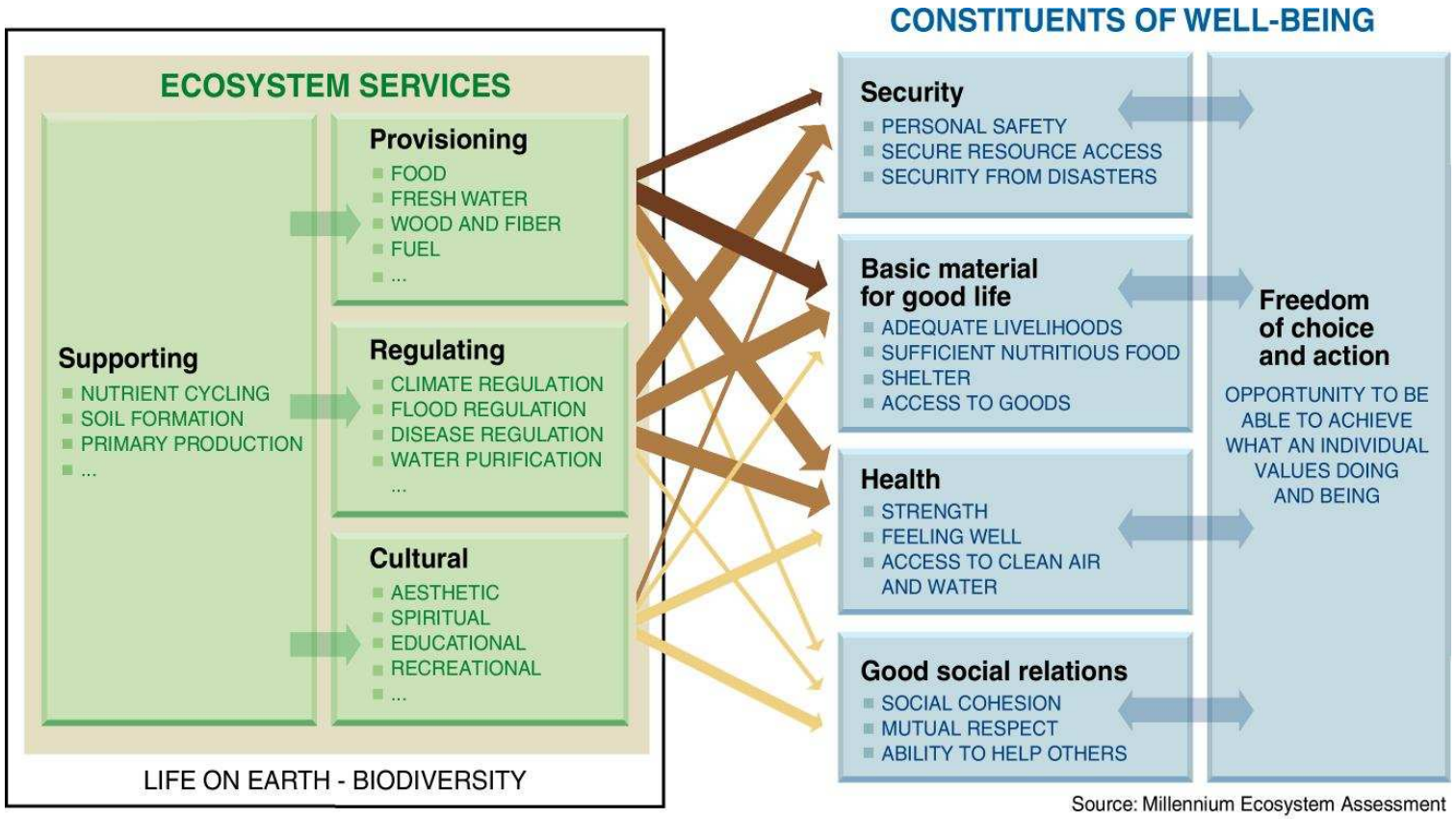
Reflects only quantifiable assets.
Source: Friends of the Commons, *State of the Commons 2003–04*.
http://friendsofthecommons.org/understanding/worth.html. Reprinted with permission.

Ecosystem services are the benefits humans derive from ecosystem functioning

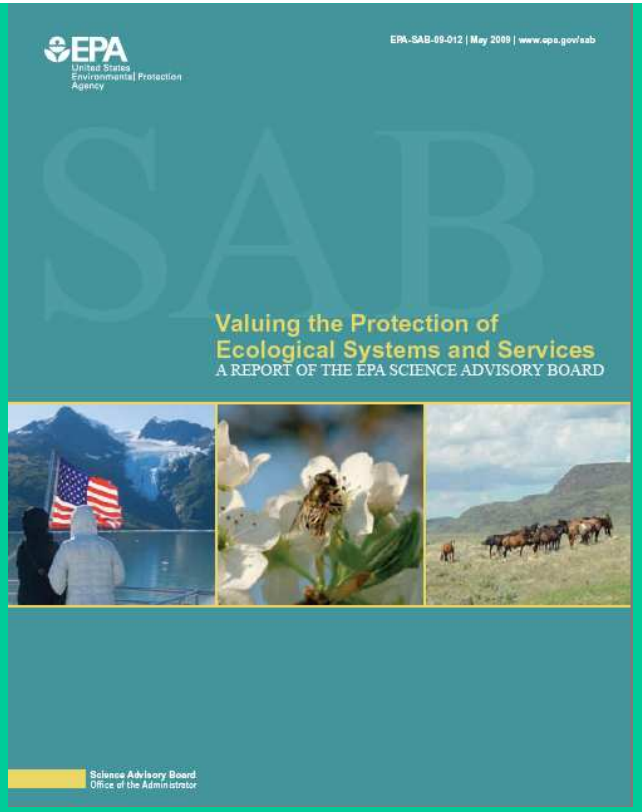
ECOSYSTEM SERVICES	ECOSYSTEM FUNCTIONS
Gas regulation	Regulation of atmospheric chemical composition.
Climate regulation	Regulation of global temperature, precipitation, and other biologically mediated climatic processes at global, regional, or local levels.
Disturbance regulation	Capacitance, damping and integrity of ecosystem response to environmental fluctuations.
Water regulation	Regulation of hydrological flows.
Water supply	Storage and retention of water.
Erosion control and sediment retention	Retention of soil within an ecosystem.
Soil formation	Soil formation processes.
Nutrient cycling	Storage, internal cycling, processing, and acquisition of nutrients.
Waste treatment	Recovery of mobile nutrients and removal or breakdown of excess or xenic nutrients and compounds.
Pollination	Movement of floral gametes.
Biological control	Trophic-dynamic regulations of populations.
Refugia	Habitat for resident and transient populations.
Food production	That portion of gross primary production extractable as food.
Raw materials	That portion of gross primary production extractable as raw materials.
Genetic resources	Sources of unique biological materials and products.
Recreation	Providing opportunities for recreational activities.
Cultural	Providing opportunities for non-commercial uses.

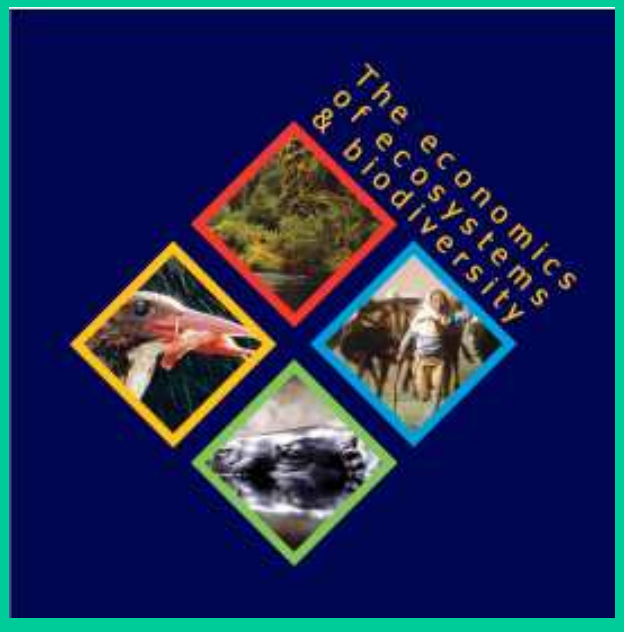
From: Costanza, R. R. d'Arge, R. de Groot, S. Farber, M. Grasso, B. Hannon, S. Naeem, K. Limburg, J. Paruelo, R.V. O'Neill, R. Raskin, P. Sutton, and M. van den Belt. 1997. The value of the world's ecosystem services and natural capital. *Nature* 387:253-260

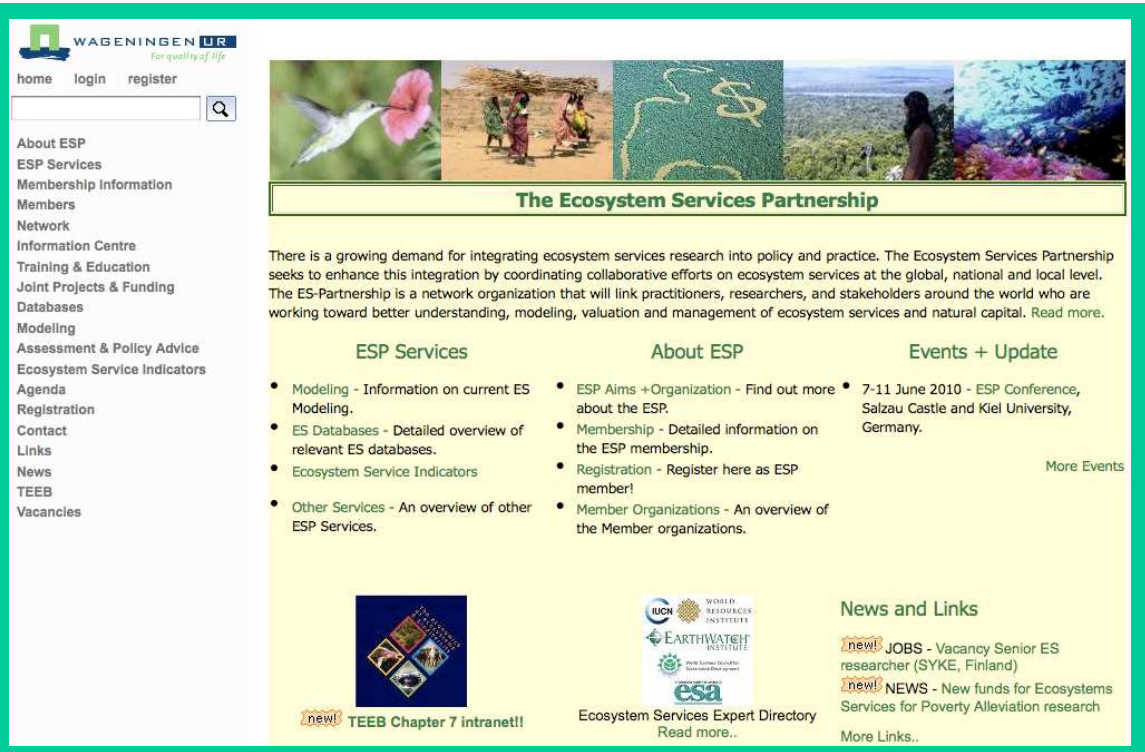
Ecosystem Services: the benefits humans derive from ecosystems



Source: Millennium Ecosystem Assessment



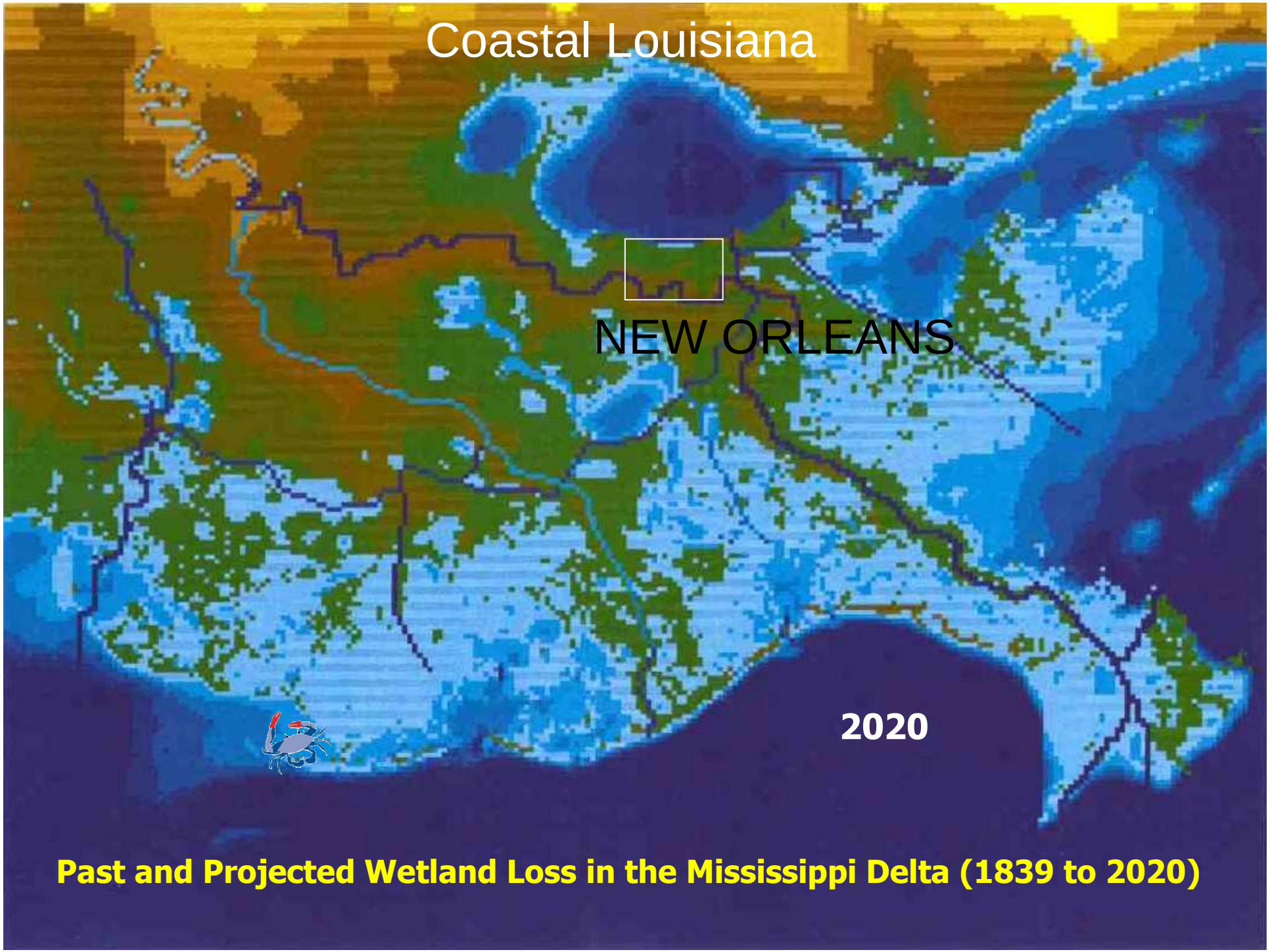




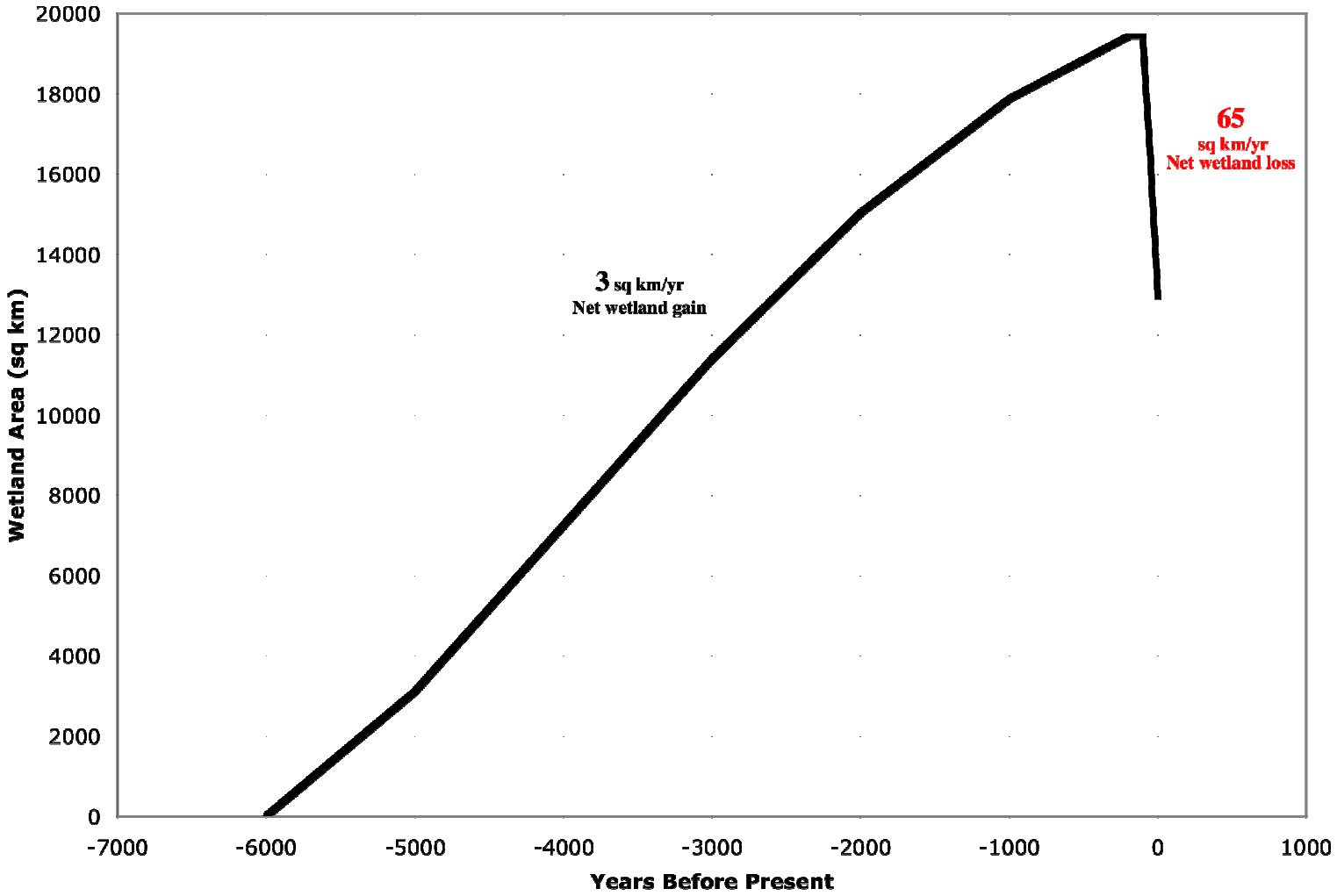
USDA announces new Office Of Ecosystem Services And Markets

Dec 29, 2008 10:16 AM

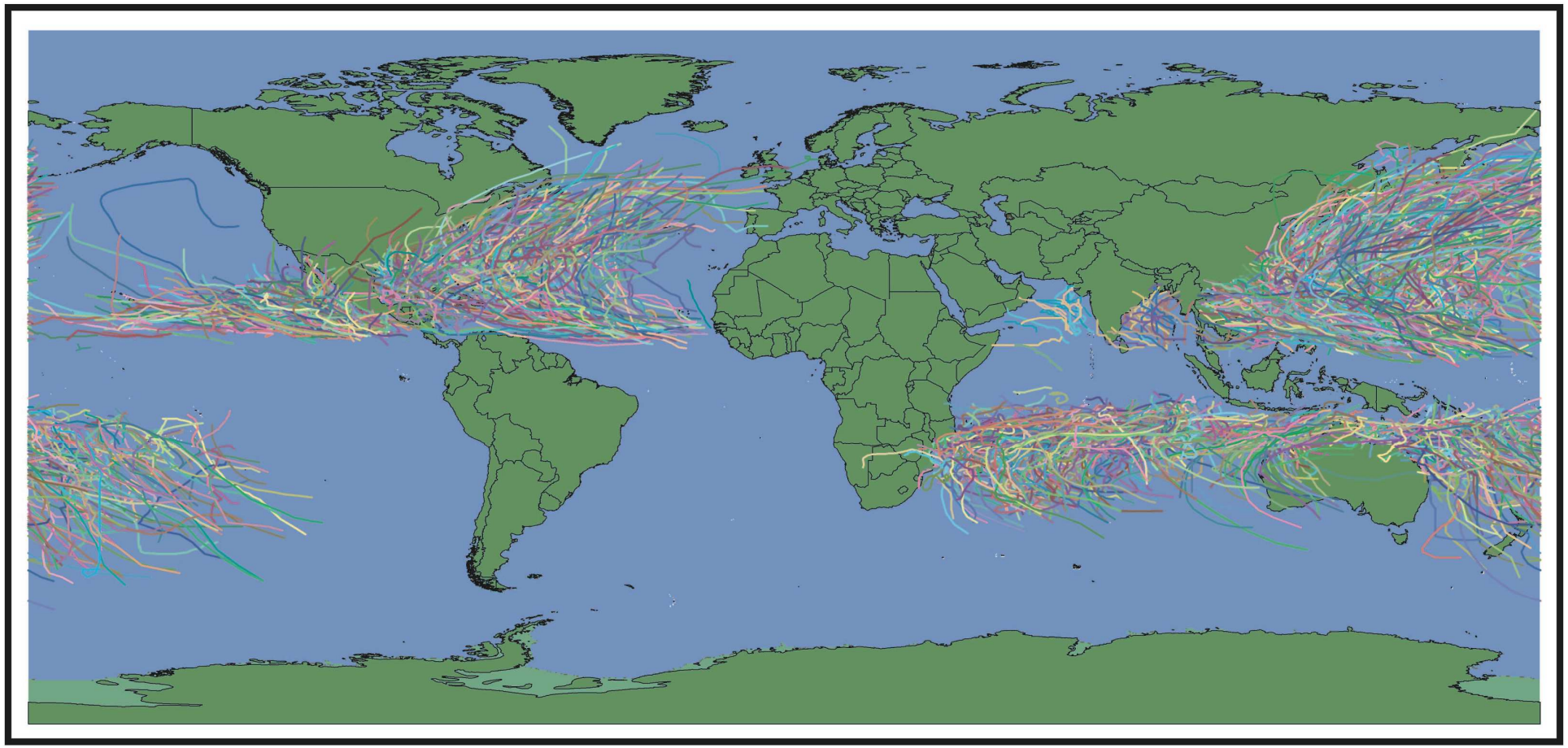
Picture taken by an automatic camera located at an electrical generating facility on the Gulf Intracoastal Waterway (GIWW) where the Route I-510 bridge crosses the GIWW. This is close to where the Mississippi River Gulf Outlet (MRGO) enters the GIWW. The shot clearly shows the storm surge, estimated to be 18-20 ft. in height..



Past and Projected Wetland Loss in the Mississippi Delta (1839 to 2020)



History of coastal Louisiana wetland gain and loss over the last 6000 years, showing historical net rates of gain of approximately 3 km^2/year over the period from 6000 years ago until about 100 years ago, followed by a net loss of approximately 65 km^2/yr since then.



Global Storm Tracks 1980 - 2006

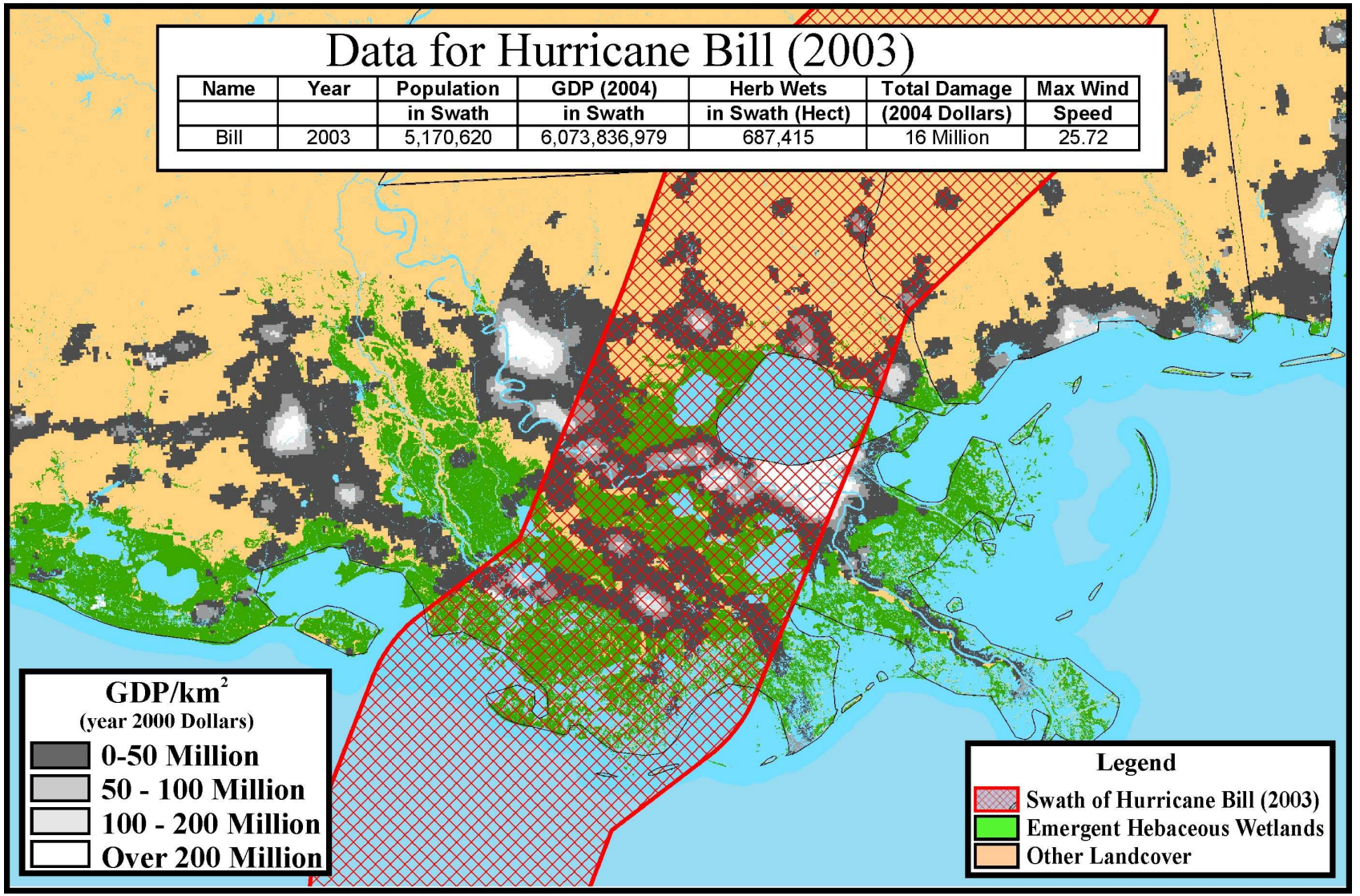


Figure 1. Typical hurricane swath showing GDP and wetland area used in the analysis.

The value of coastal wetlands for hurricane protection

$$\ln(TD_i/GDP_i) = \alpha + \beta_1 \ln(g_i) + \beta_2 \ln(w_i) + u_i \qquad (1)$$

Where:

TD_i = total damages from storm i (in constant 2004 $US);

GDP_i = Gross Domestic Product in the swath of storm i (in constant 2004 $US). The swath was considered to be 100 km wide by 100 km inland.

g_i = maximum wind speed of storm i (in m/sec)

w_i = area of herbaceous wetlands in the storm swath (in ha).

u_i = error

Predicted total damages from storm *i*

$$TD_i = e^{\alpha} * g_i^{\beta_1} * w_i^{\beta_2} * GDP_i$$

Avoided cost from a change of 1 ha of coastal wetlands for storm *i*

$$\Delta TD_i = e^{\alpha} * g_i^{\beta_1} * \left((w_i - 1)^{\beta_2} - w_i^{\beta_2}\right) * GDP_i$$

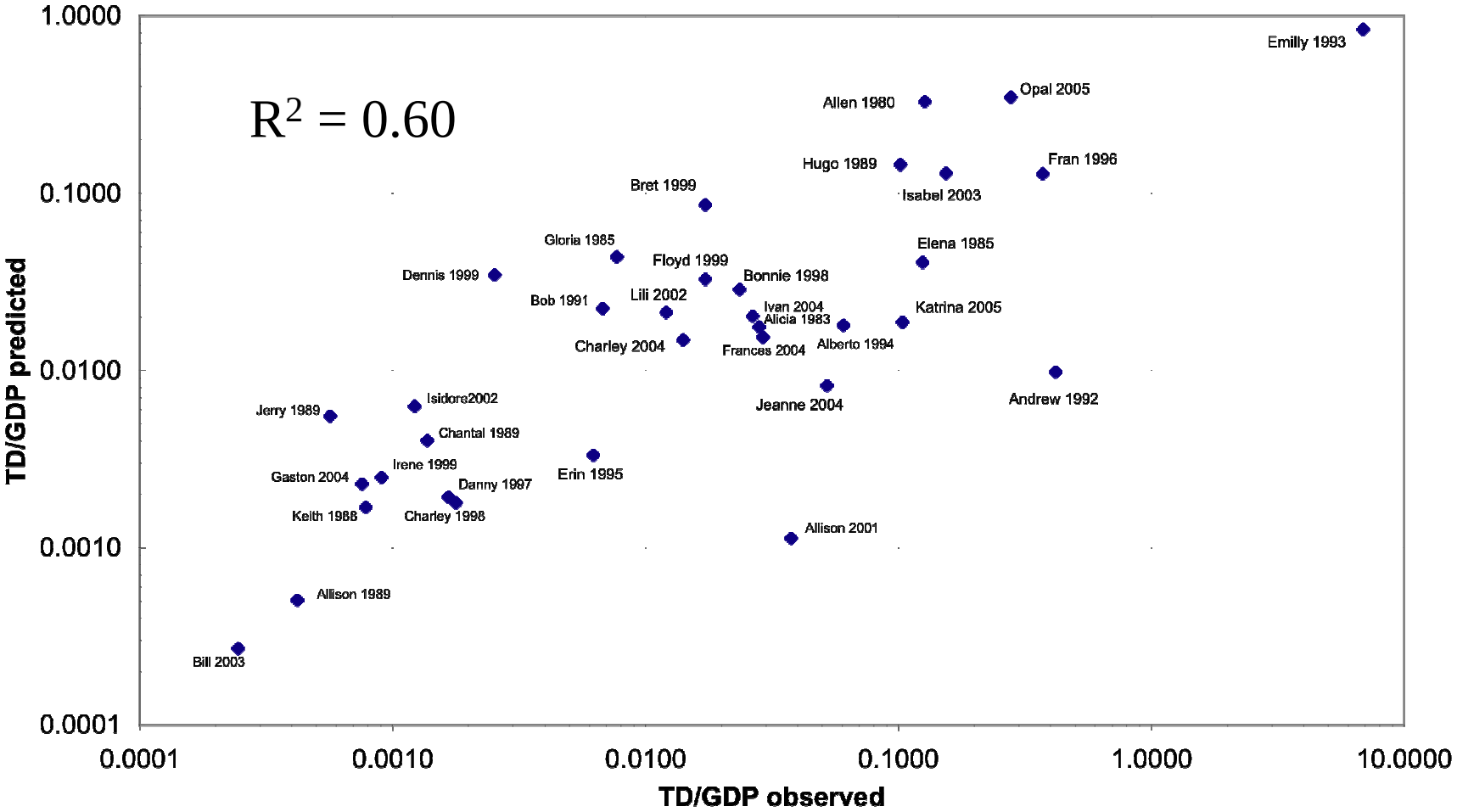
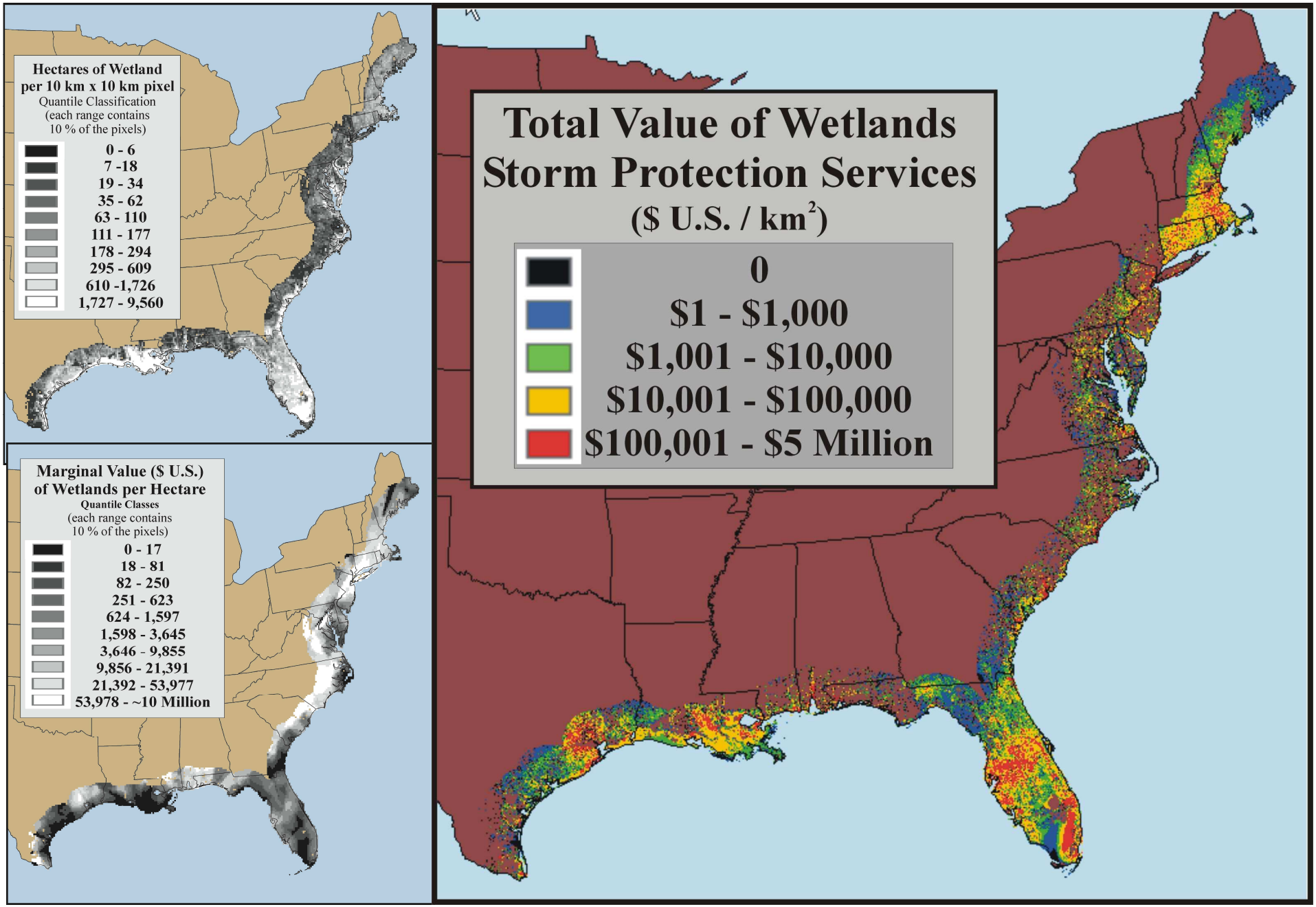


Figure 2. Observed vs. predicted relative damages (TD/GDP) for each of the hurricanes used in the analysis.


Hectares of Wetland
per 10 km x 10 km pixel
Quantile Classification
(each range contains
10 % of the pixels)
0 - 6
7 -18
19 - 34
35 - 62
63 - 110
111 - 177
178 - 294
295 - 609
610 -1,726
1,727 - 9,560
Marginal Value ($ U.S.)
of Wetlands per Hectare
Quantile Classes
(each range contains
10 % of the pixels)
0 - 17
18 - 81
82 - 250
251 - 623
624 - 1,597
1,598 - 3,645
3,646 - 9,855
9,856 - 21,391
21,392 - 53,977
53,978 - ~10 Million
Total Value of Wetlands
Storm Protection Services
($ U.S. / km2)
0
$1 - $1,000
$1,001 - $10,000
$10,001 - $100,000
$100,001 - $5 Million

•**A loss of 1 ha of wetland in the model corresponded to an average $33,000 (median = $5,000) increase in storm damage from specific storms.**

•**Taking into account the annual probability of hits by hurricanes of varying intensities, the annual value of coastal wetlands ranged from $250 to $51,000/ha/yr, with a mean of $8,240/ha/yr (median = $3,230/ha/yr)**

• **Coastal wetlands in the US were estimated to currently provide $23.2 Billion/yr in storm protection services.**

From: Costanza, R., O. Pérez-Maqueo, M. L. Martinez, P. Sutton, S. J. Anderson, and K. Mulder. 2008. The value of coastal wetlands for hurricane protection. *Ambio* 37:241-248

Gund Institute for Ecological Economics University of Vermont

NATURE |VOL 387 | 15 MAY 1997 **253**

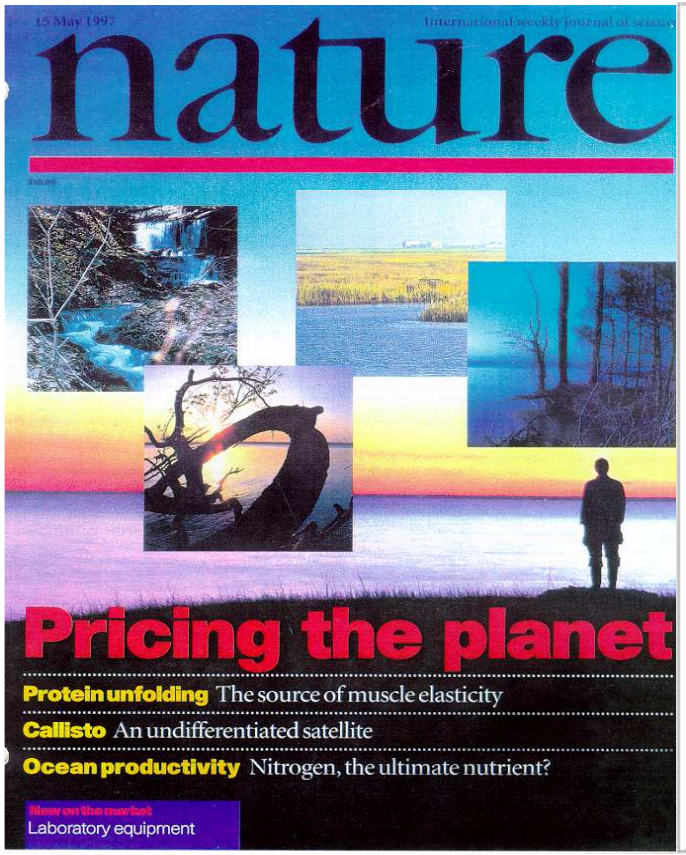
2nd most cited article in the last 10 years in the Ecology/Environment area according to the ISI Web of Science.

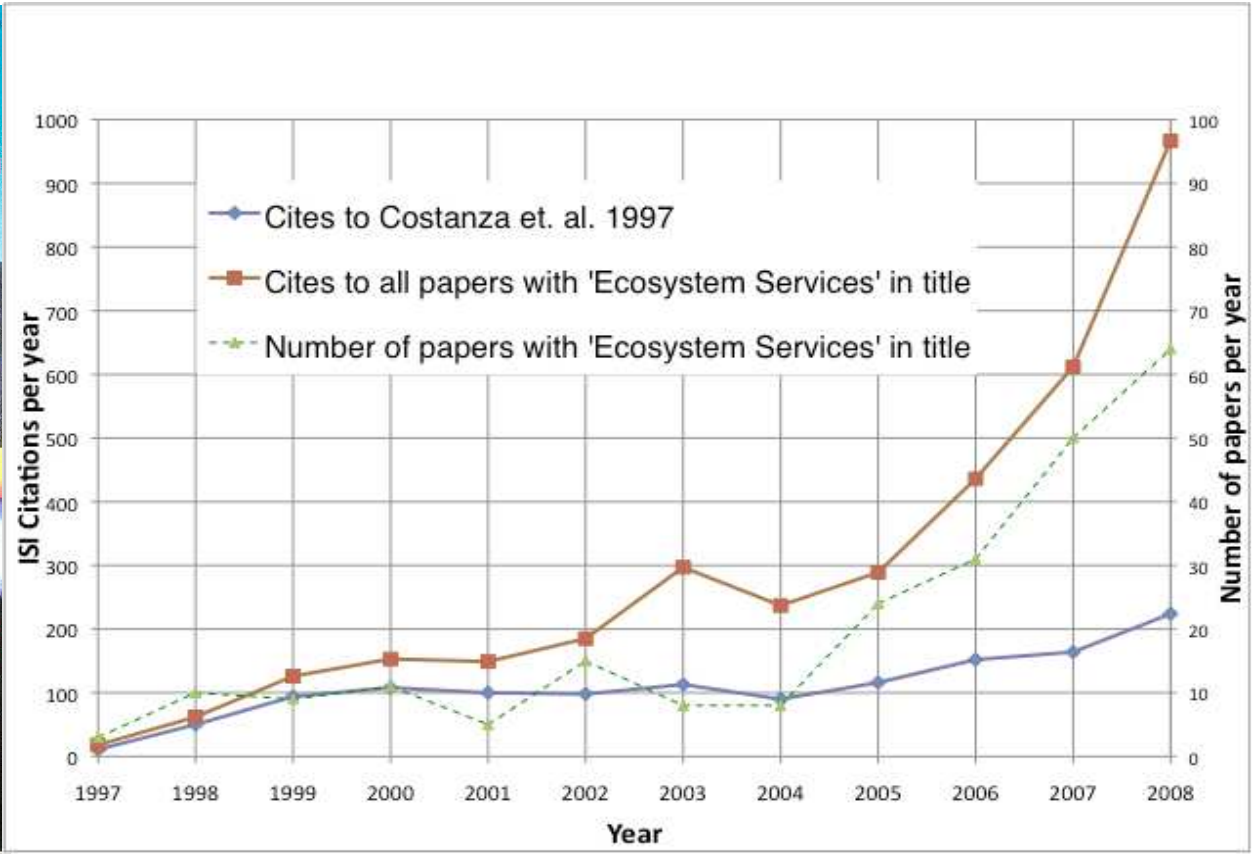
The value of the world's ecosystem services and natural capital

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 Sutton & Marjan van den Belt

*

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 ($10^{12}$) per year, with an average of US$33trillion 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.





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

Biome	Area (e6 ha)	Value per ha ($/ha/yr)	Global Flow Value (e12 $/yr)
Marine	**36,302**	**577**	**20.9**
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
Terrestrial	**15,323**	**804**	**12.3**
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		
Total	51,625		**33.3**

Problems with the *Nature* paper
(as listed in the paper itself)

1. Incomplete (not all biomes studied well - some not at all)
2. Distortions in current prices are carried through the analysis
3. Many estimates based on current willingness-to-pay or proxies
4. Probably underestimates changes in supply and demand curves as ecoservices become more limiting
5. Assumes smooth responses (no thresholds or discontinuties)
6. **Assumes spatial homogeneity of services within biomes**
7. Partial equilibrium framework
8. Not necessarily based on sustainable use levels
9. Does not fully include “infrastructure” value of ecosystems
10. Difficulties and imprecision of making cross-country comparisons
11. Discounting (for the few cases where we needed to convert from stock to flow values)
12. Static snapshot; no dynamic interactions

Solving any of these problems (except perhaps 6 which could go either way) will most likely lead to larger values

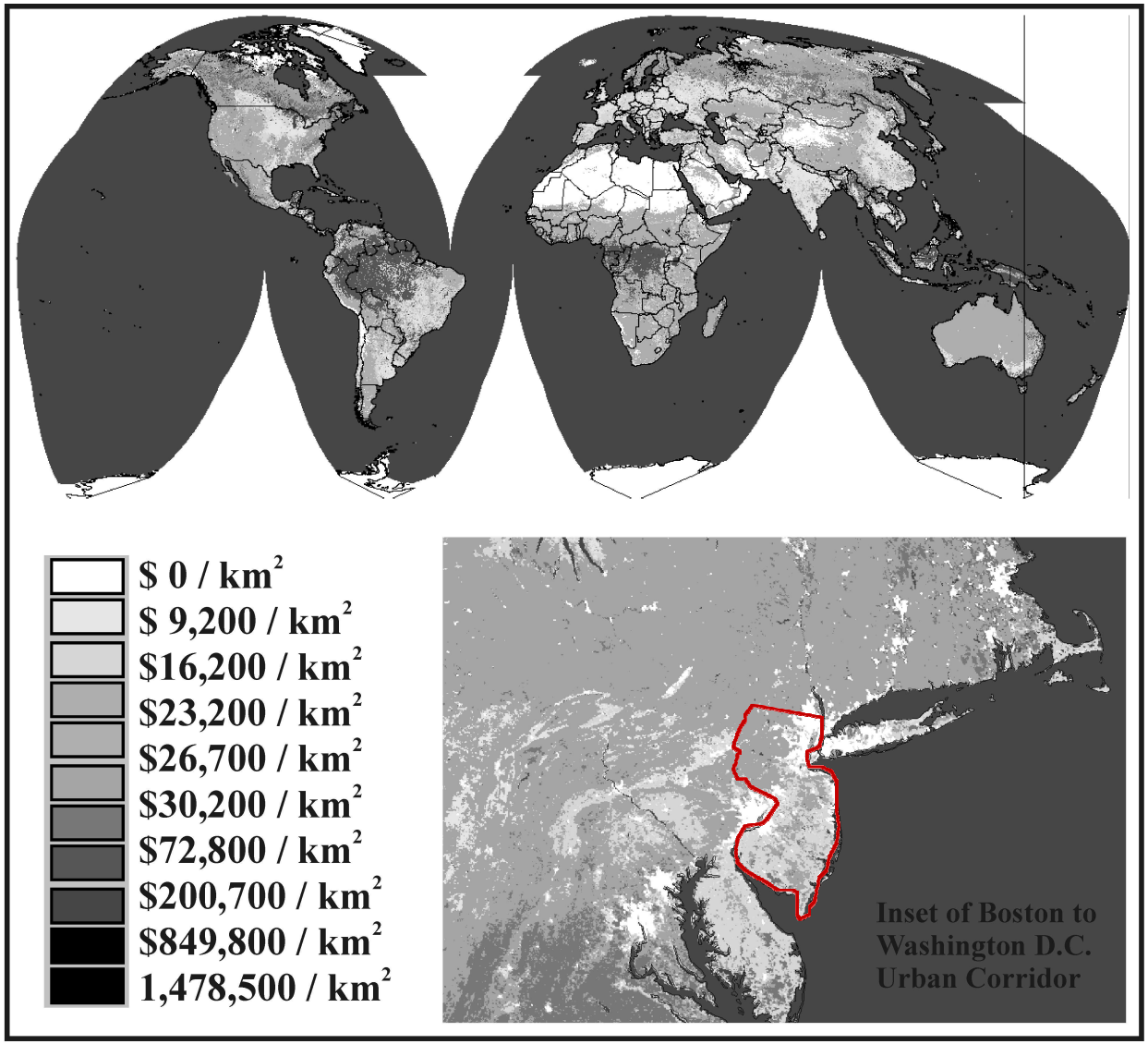


Figure 3: Global Map of Non-Marketed Economic Activity (ESP) arising from Ecosystem Services and derived from Land Cover at 1 km² (For National Totals See Table 1)

http://www.nj.gov/dep/dsr/naturalcap/

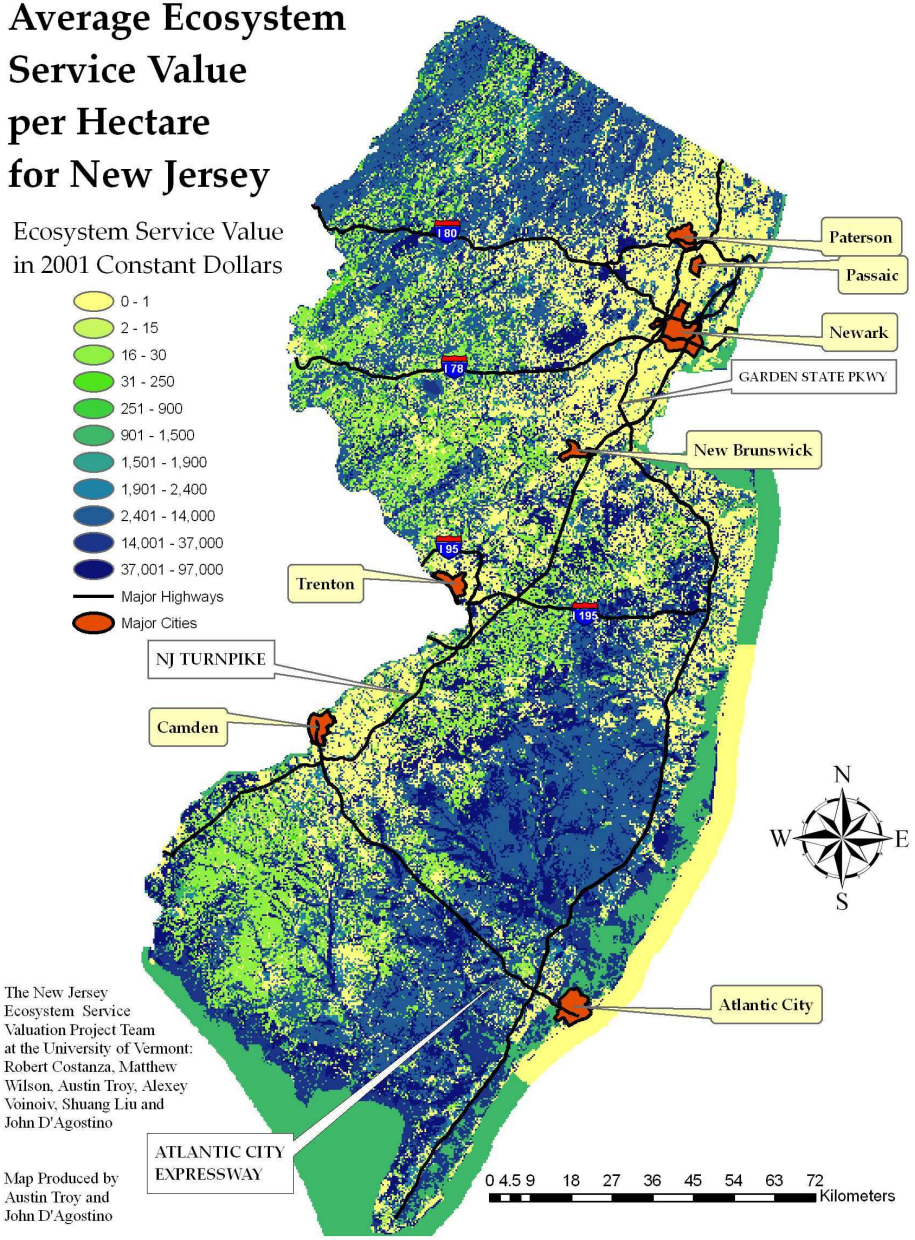
Valuing New Jersey's Natural Capital:

An Assessment of the Economic Value of the State's Natural Resources

April 2007

State of New Jersey
New Jersey Department of Environmental Protection
Jon S. Corzine, Governor
Lisa P. Jackson, Commissioner

Average Ecosystem Service Value per Hectare for New Jersey

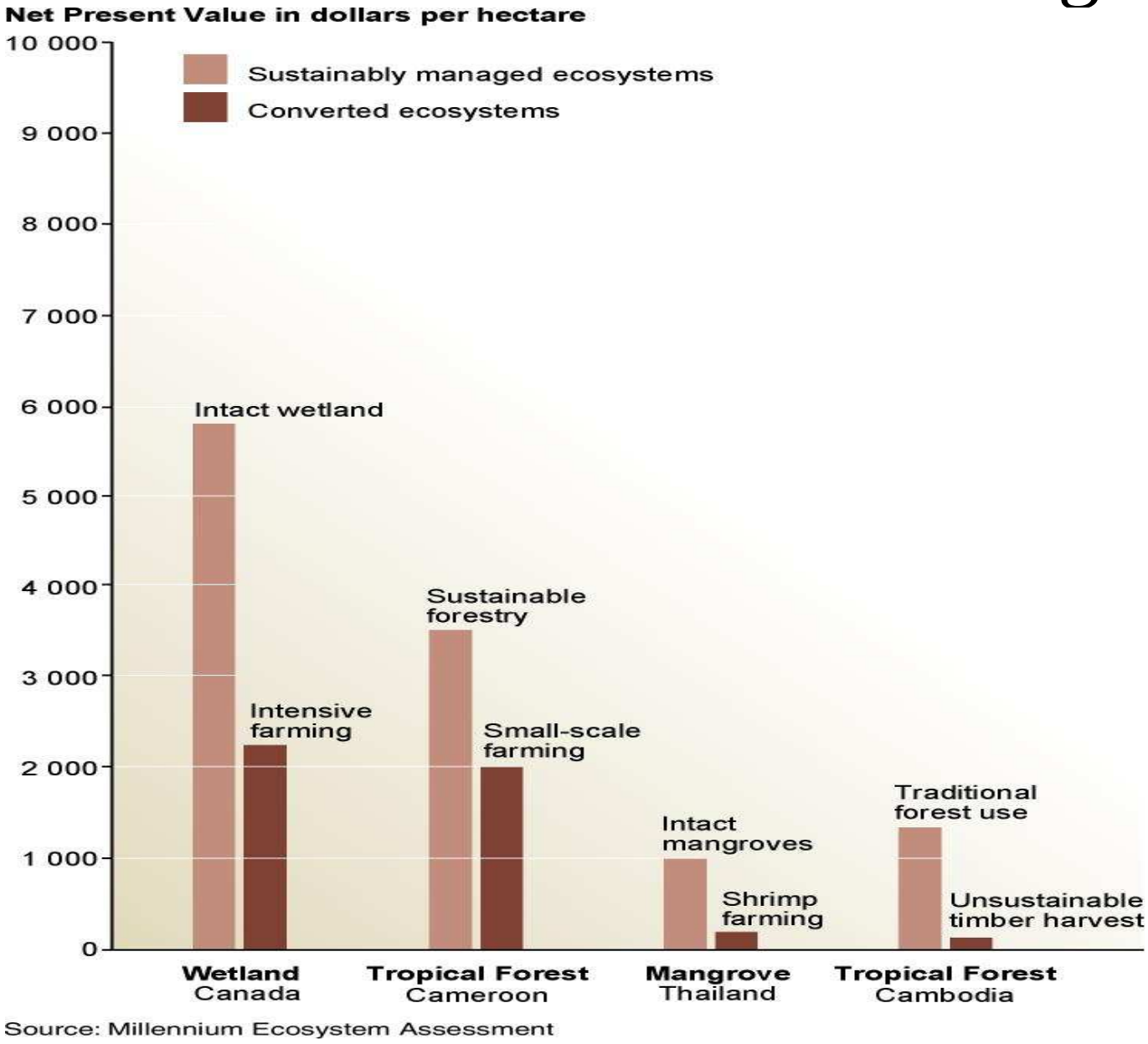


The New Jersey Ecosystem Service Valuation Project Team at the University of Vermont: Robert Costanza, Matthew Wilson, Austin Troy, Alexey Voinoiv, Shuang Liu and John D'Agostino

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



Source: Millennium Ecosystem Assessment

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)

Integrated Modeling of Humans Embedded in Ecological Systems

- **Intelligent Pluralism (Multiple Modeling Approaches), Testing, Cross-Calibration, and Integration**
- **Multi-scale in time, space, and complexity**
- **Can be used as a Consensus Building Tool in an Open, Participatory Process**
- **Acknowledges Uncertainty and Limited Predictability**
- **Acknowledges Values of Stakeholders**
- **Evolutionary Approach Acknowledges History, Limited Optimization, and the Co-Evolution of Human Culture and Biology with the Rest of Nature**

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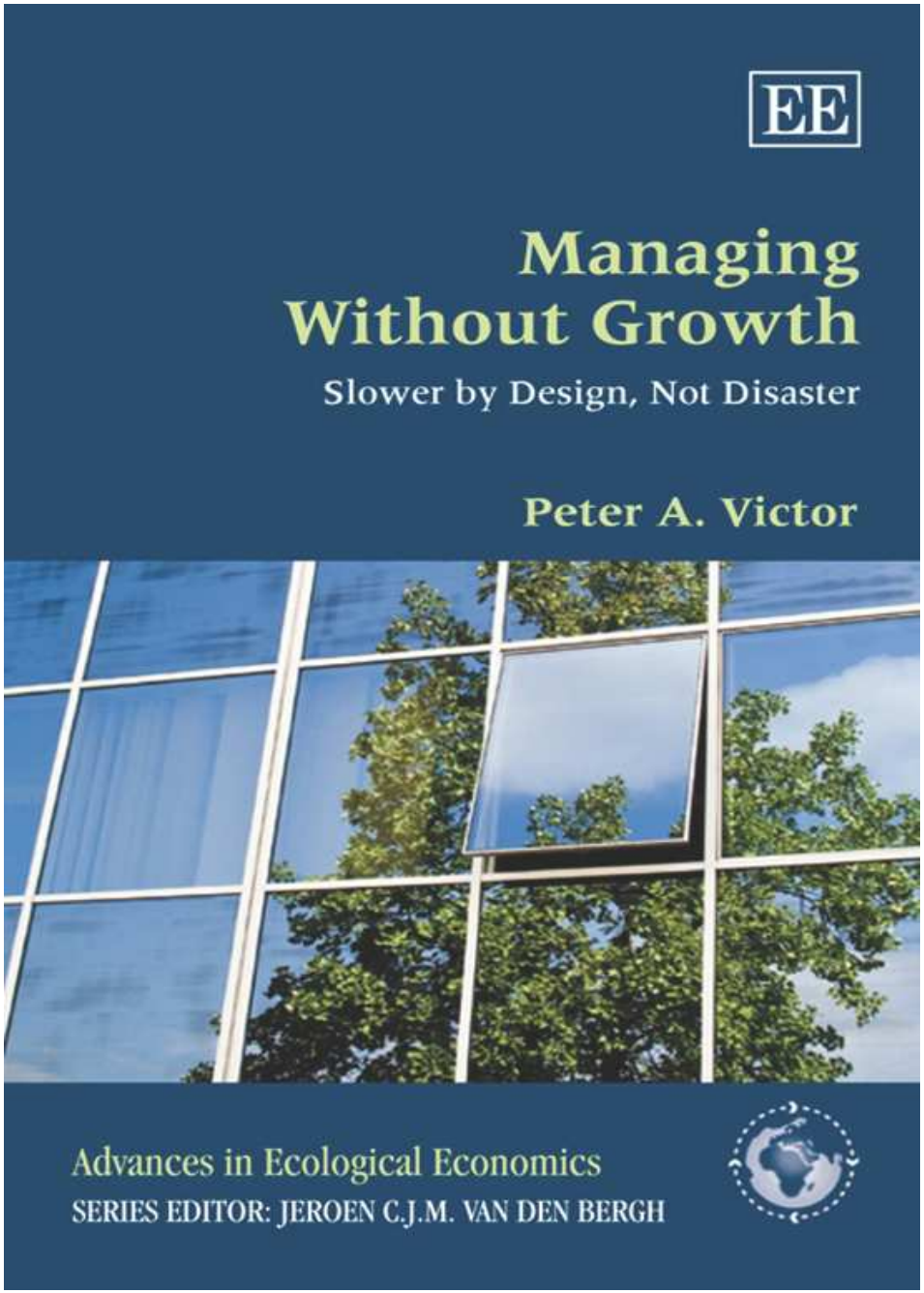
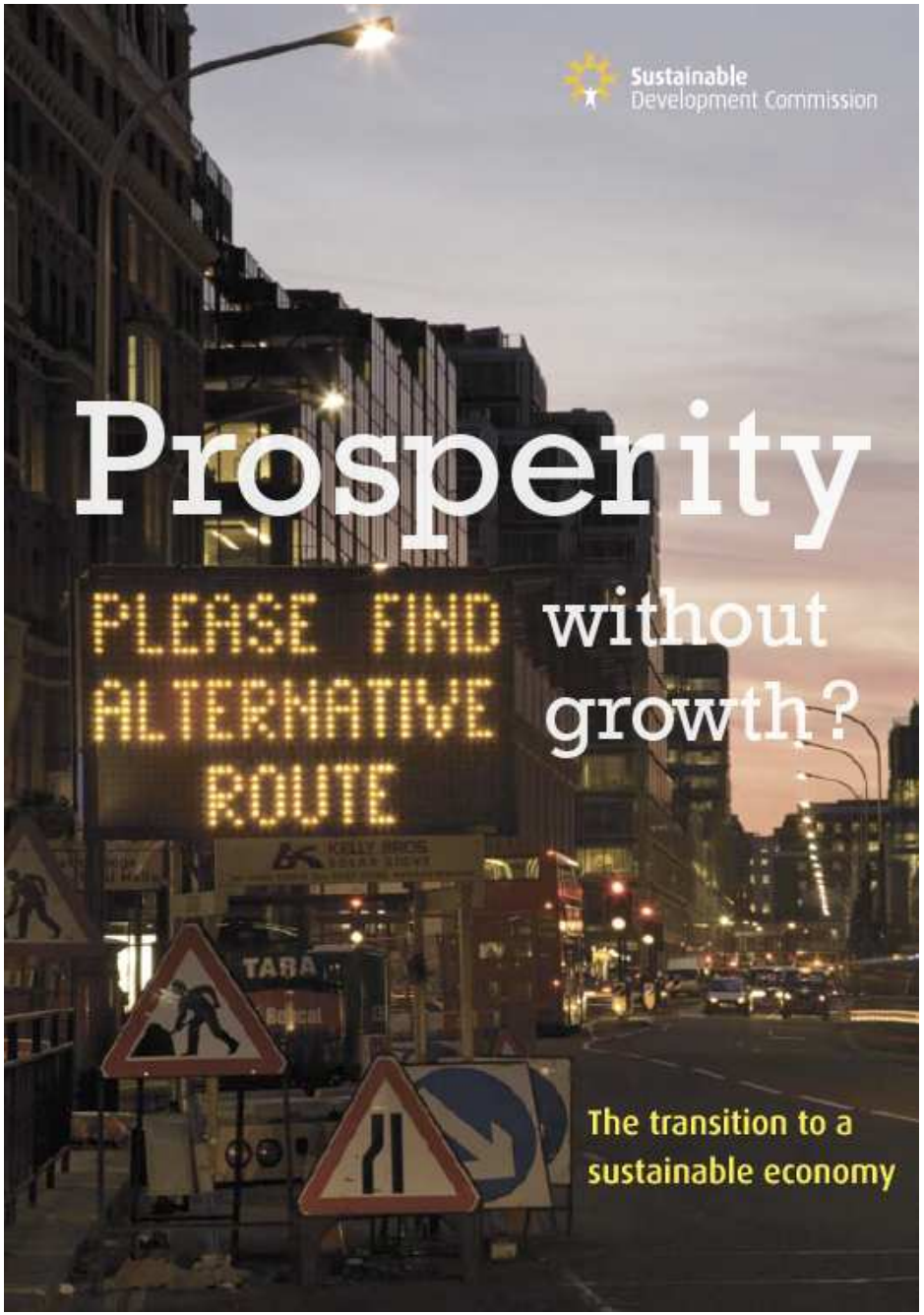
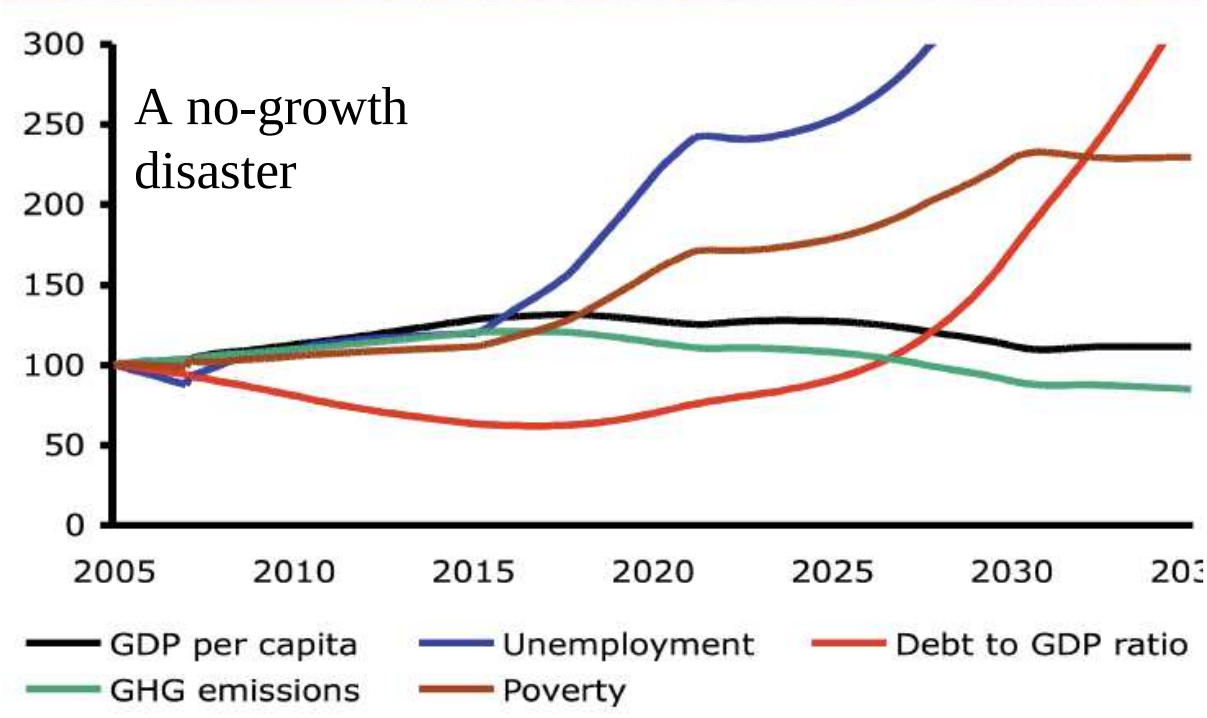
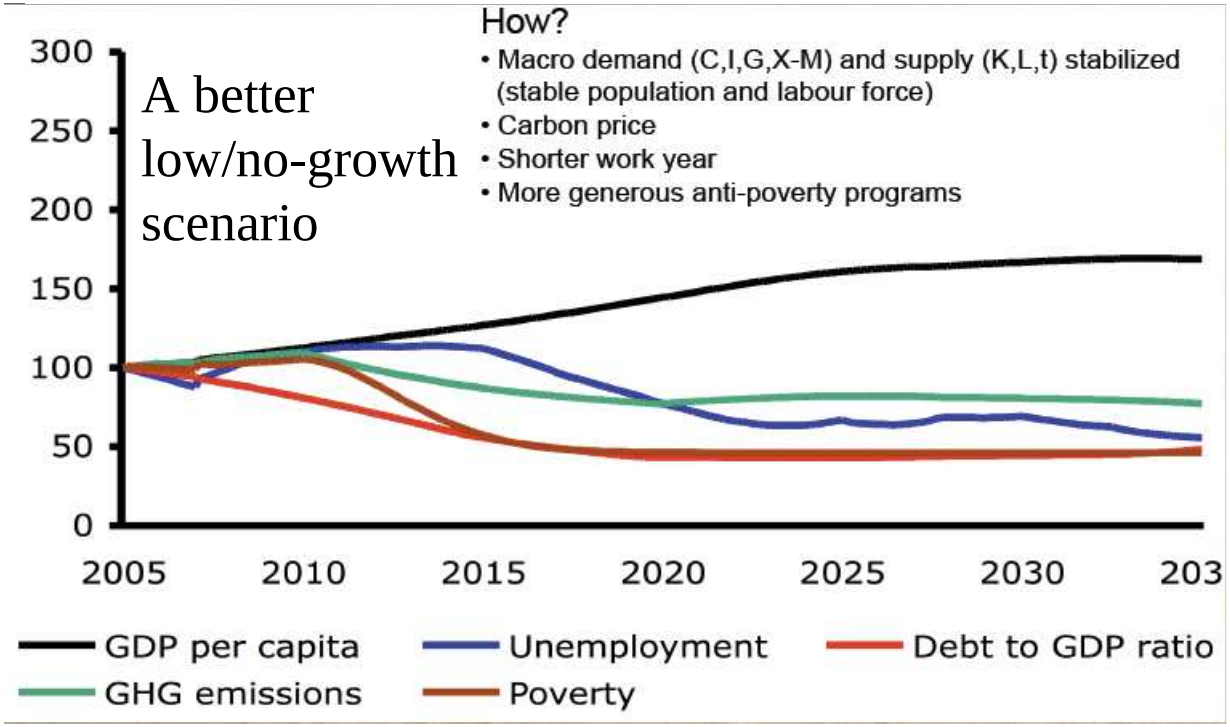

EE
Managing Without Growth
Slower by Design, Not Disaster
Peter A. Victor
Advances in Ecological Economics
SERIES EDITOR: JEROEN C.J.M. VAN DEN BERGH


Sustainable Development Commission
Prosperity without growth?
PLEASE FIND ALTERNATIVE ROUTE
The transition to a sustainable economy

•**What would change?**
•New meanings and measures of success
•Limits on materials, energy, wastes and land
•Use
•More meaningful prices
•More durable, repairable products
•Fewer status goods
•More informative advertising
•Better screening of technology
•More efficient capital stock
•More local, less global
•Reduced inequality
•Less work, more leisure
•Education for life not just work

Source: Victor, P. 2008. Managing without growth: slower by design not disaster. Edward Elgar





Macroeconomic policy directions for low/no growth

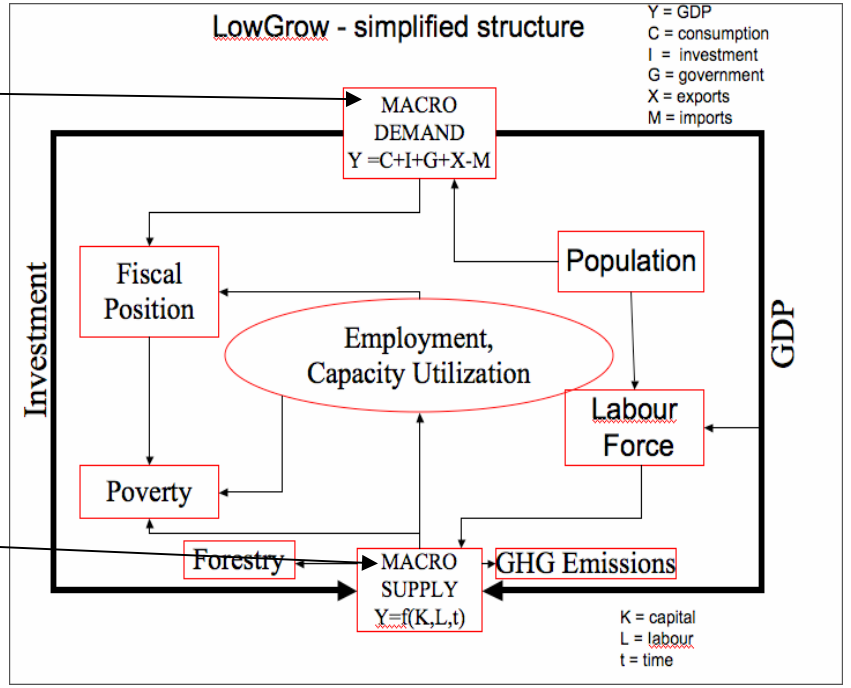
(from Victor, P. 2008, Managing without growth)

Macro Demand:

- Consumption: stabilize, fewer status goods, more public goods
- Investment: zero net investment, shift to green/clean and public goods
- Government: stabilize
- Trade: balanced
- Population: stabilize

Macro Supply:

- Capital: stabilize, change composition
- Labour force: stabilize
- Technological change: slower, more discriminating, preventative
- Work time: reduce, more leisure



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 external cost and benefit accounting (e.g. www.TruCost.com)**
- **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)**
- **Expand the "Commons Sector"**

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.
Barnes, P, 2006. *Capitalism 3.0: a guide to reclaiming the commons* Berrett-Koehler

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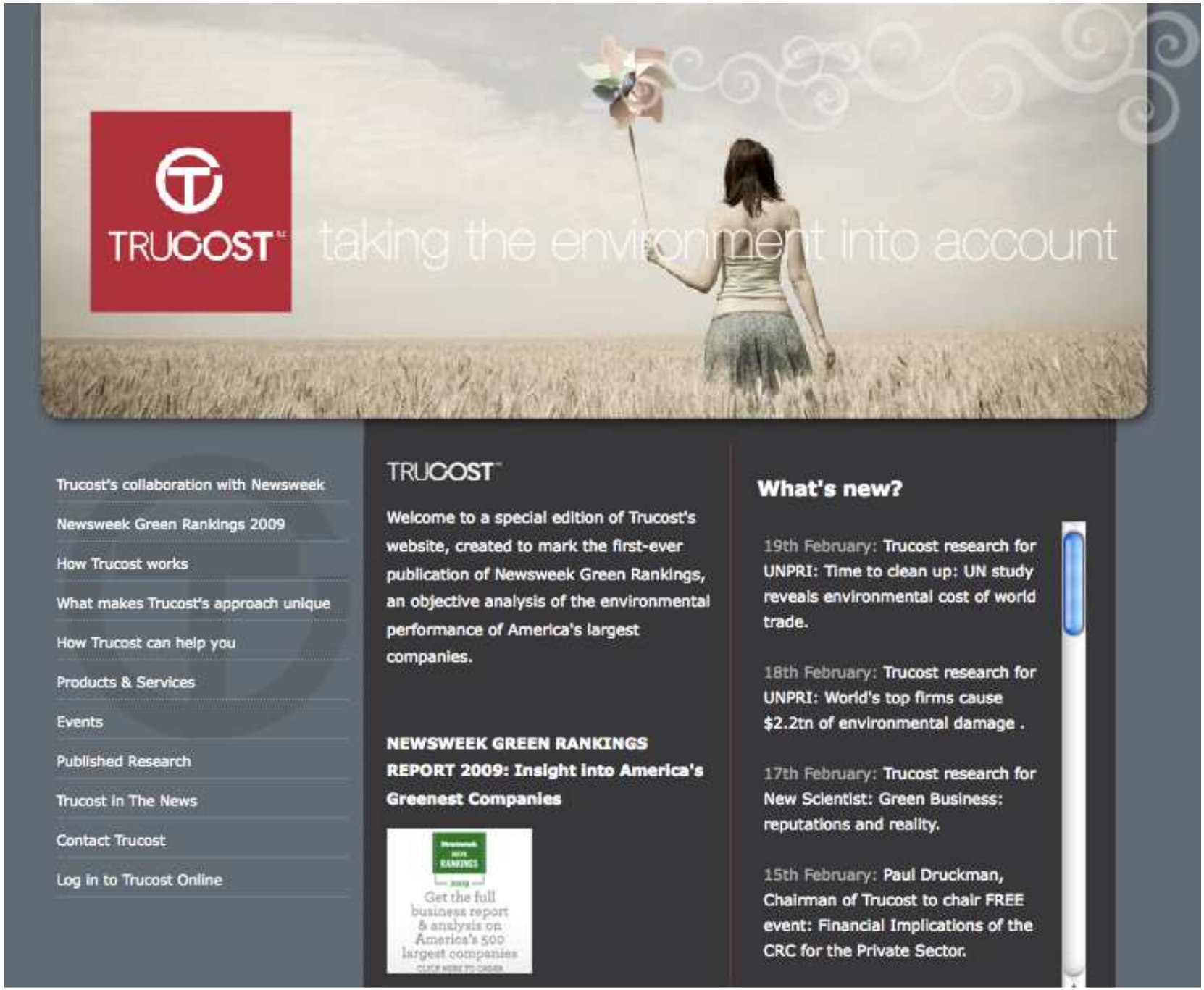
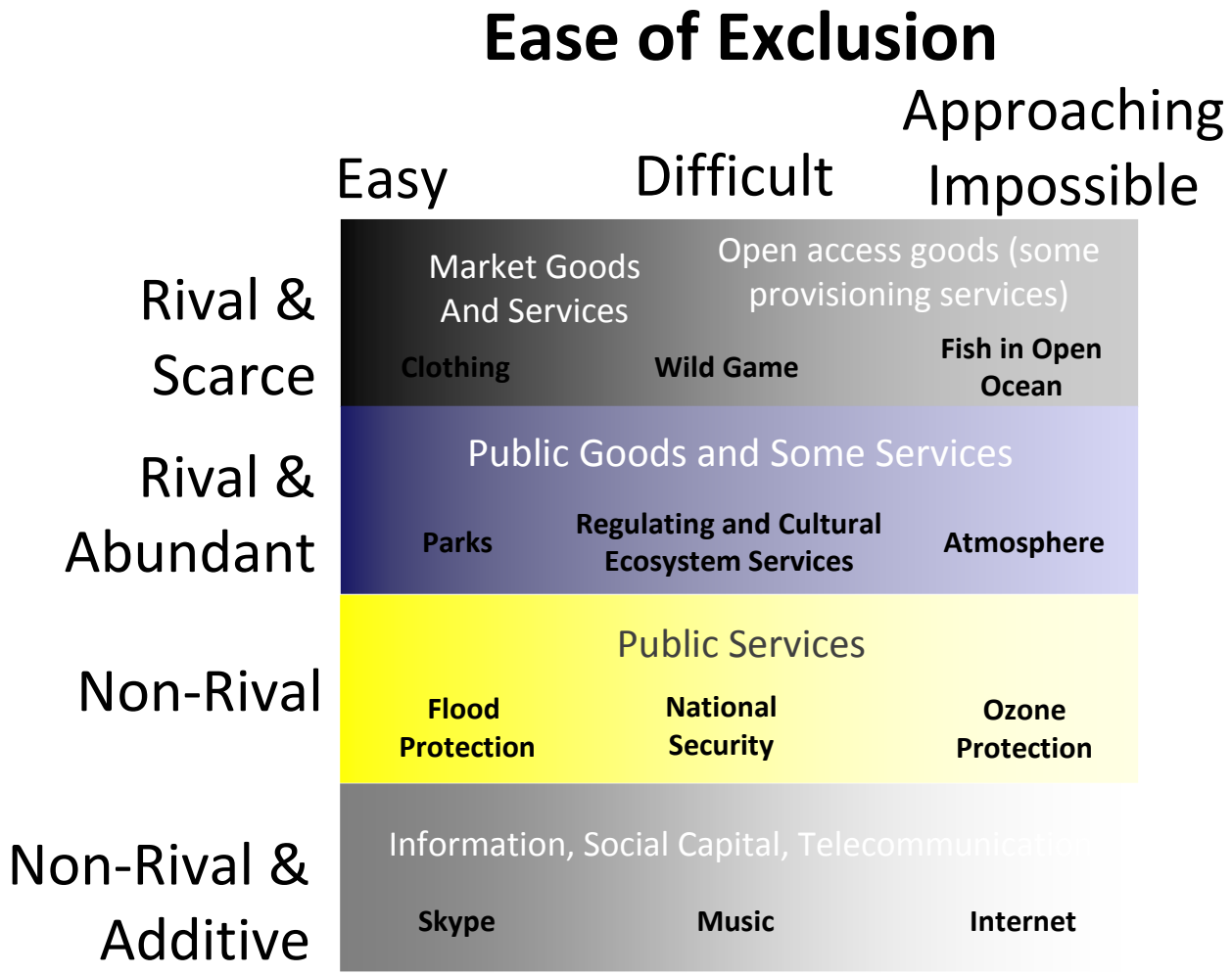
www.trucost.com





Source: Kubiszewski, I. 2010. Searching for the sweet spot: managing information as a good that improves with use. Ph.D. Dissertation. University of Vermont

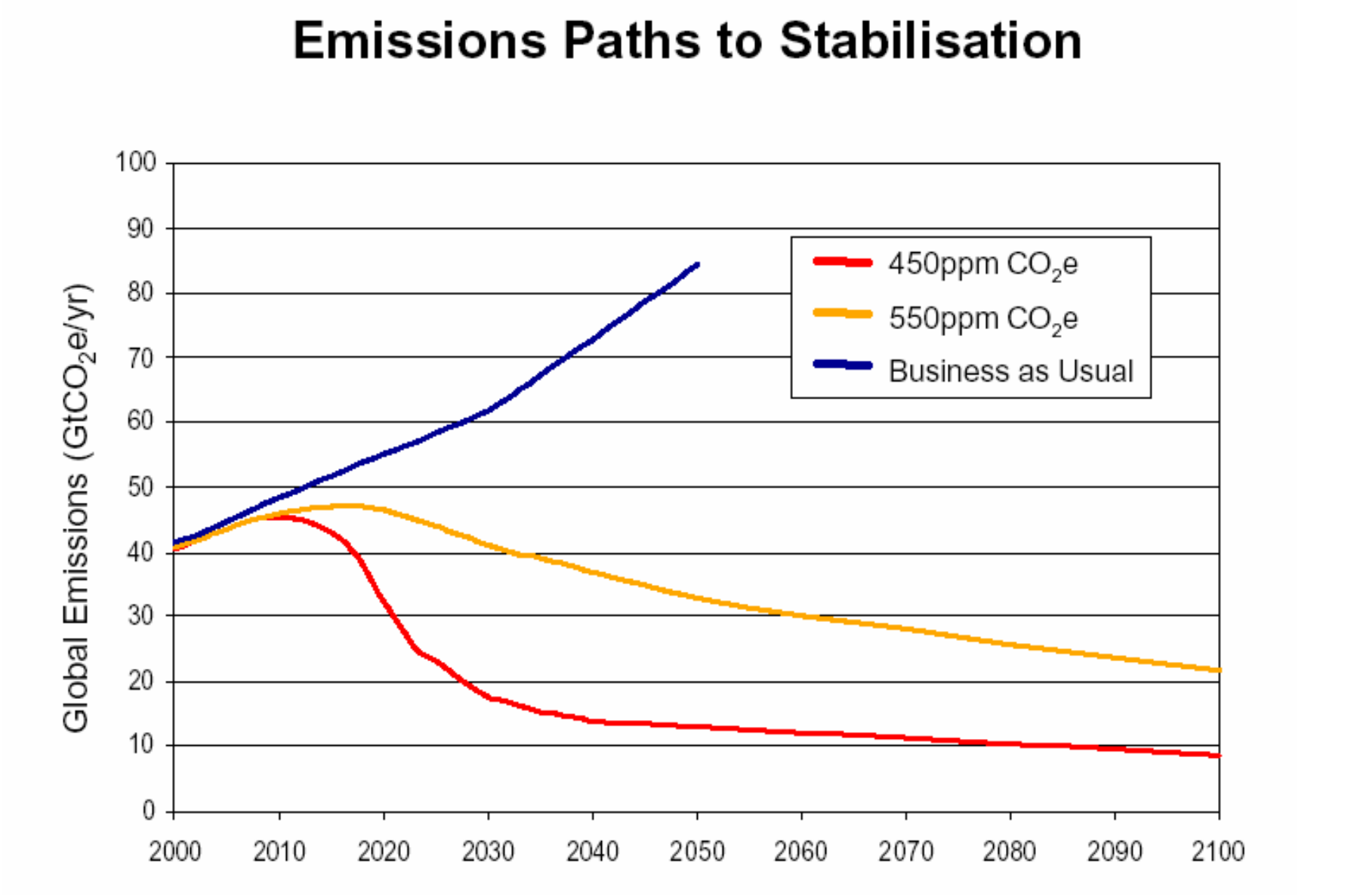
THE NEW COMMONS SECTOR

Global
• Earth Atmospheric Trust

National
• American Permanent Fund
• Children's start-up trust
• Universal health insurance
• Copyright royalty fund
• Spectrum trust
• Commons tax credit…

Regional
• Regional watershed trusts
• Regional airshed trusts
• Mississippi basin trust
• Buffalo commons
• Vermont Common Asset Trust…

Local
• Land trusts
• Municipal wi-fi
• Community gardens
• Farmers' markets
• Public spaces
• Car-free zones
• Time banks…



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

An Earth Atmospheric Trust

(similar to the current US Cantwell-Collins CLEAR Act)

A system to stop global warming *and* reduce poverty

See: Barnes, P., R. Costanza, P. Hawken, D. Orr, E. Ostrom, A. Umaña, and O. Young. *Science*. 319:724 (2008)
See also: Barnes. P and B. McKibben, *Solutions* 1(1) www.thesolutionsjournal.org

1)Set up a global cap/auction/dividend 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 350 ppm target**. The price of permits will go up and total revenues will increase as the cap is reduced.

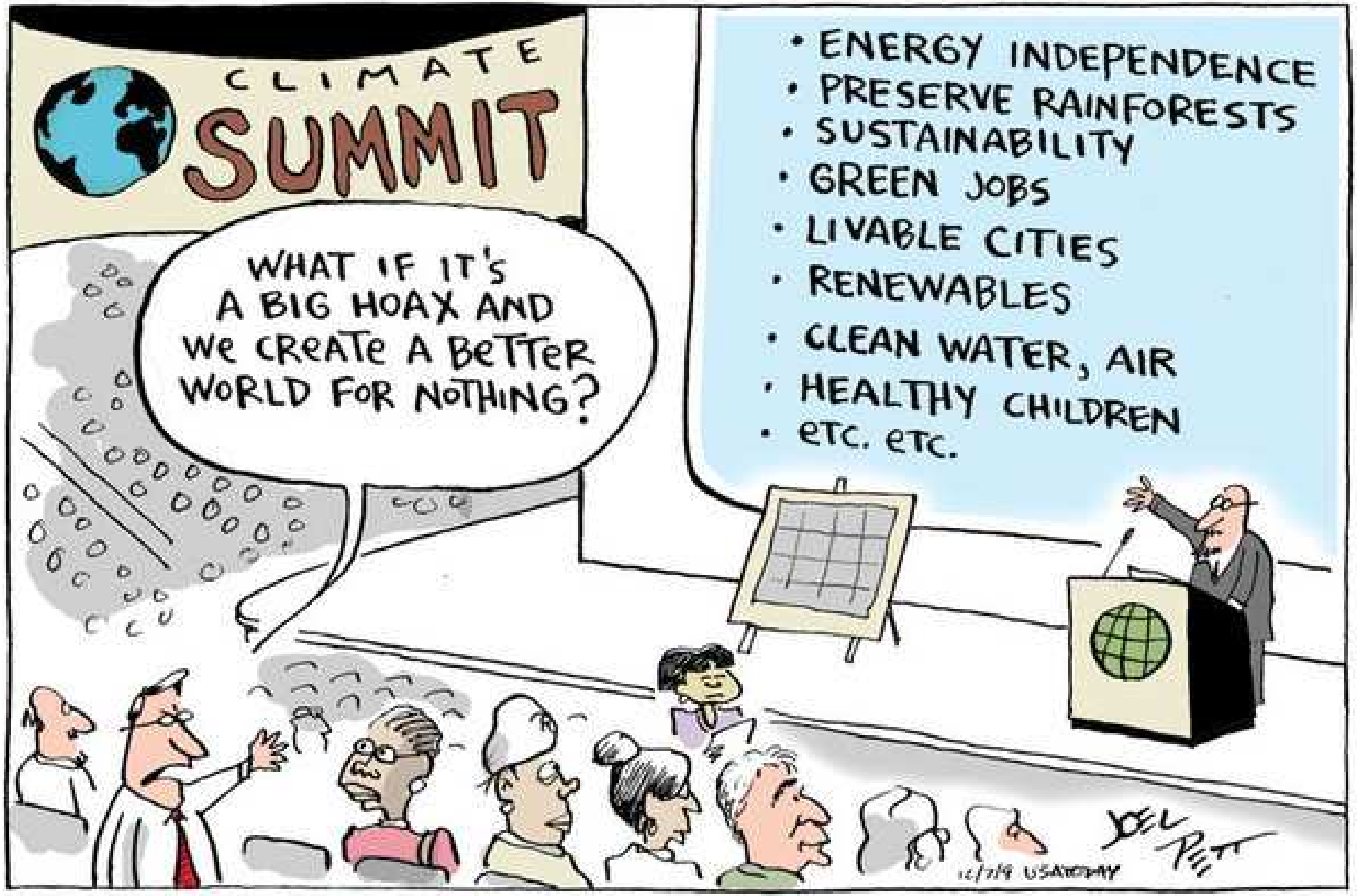
4) **Deposit the revenues into a trust fund**, managed by trustees appointed with long terms and a mandate to protect the asset (the climate and atmosphere)

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 (especially in the developing world), research and development on renewable energy, payments for ecosystem services such as carbon sequestration, etc.

The transition to a “sustainable quality of life” “lagom” economy requires:

- **The wide-scale conversion of built capital** to use sustainable, renewable energy with massive targeted investments in wind and solar, high efficiency smart power grids, effective mass transit, and high efficiency buildings and cars.
- **The full utilization of human capital** by focusing on fulfilling work, full employment, universal access to quality education through college and beyond, universal access to high quality preventive health care, and limiting population.
- **The rebuilding of social capital** by rewarding community involvement and participation, reducing the gap in income and wealth, and providing fewer work hours and more leisure time to allow connection to friends, family, and the community.
- **The restoration of natural capital** by focusing on protecting and enhancing the ecosystem services on which the quality of all human life depends. Aspects of this include limiting carbon emissions to keep the atmospheric concentration below 350 ppm (an atmospheric trust/cap, auction and dividend system would work well for this), greatly expanding marine protected areas, charging fees for the depletion of and investing in the restoration of natural capital.


CLIMATE
SUMMIT
WHAT IF IT'S A BIG HOAX AND WE CREATE A BETTER WORLD FOR NOTHING?
• ENERGY INDEPENDENCE
• PRESERVE RAINFORESTS
• SUSTAINABILITY
• GREEN JOBS
• LIVABLE CITIES
• RENEWABLES
• CLEAN WATER, AIR
• HEALTHY CHILDREN
• ETC. ETC.
JOEL PETT
USATODAY

Conclusion

The long term solution to the global recession is therefore to:

•break our addictions to the "growth at all costs" economic model, to fossil fuels, and to over-consumption
•create a more sustainable and desirable future that focuses on quality of life rather than merely quantity of consumption and recognizes the contributions of natural and social capital (the new commons sector)

It will require a new vision, new measures, new institutions and new technologies. It will require a redesign of our entire society. But it is not a sacrifice of quality of life to break this addiction. Quite the contrary, it is a sacrifice not to.

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