

The National Academies of
SCIENCES • ENGINEERING • MEDICINE

**Transition toward Sustainability after 15 Years:
Where Do We Stand in Advancing the Scientific Foundation?**

January 14-15, 2016, Newport Beach CA

Integrating Metrics, Models and Visions to Transition Toward Sustainability

Robert Costanza

- Professor and Chair in Public Policy
Crawford School of Public Policy
Australian National University
Canberra ACT 2601, Australia
- Editor in Chief, *Solutions* (www.thesolutionsjournal.org)



**Australian
National
University**

Human influence on the earth system is now so large, that a new geologic epoch (*the Anthropocene*) has begun. We now live in a “Full World”

Business as usual is not an option.
We need a new system

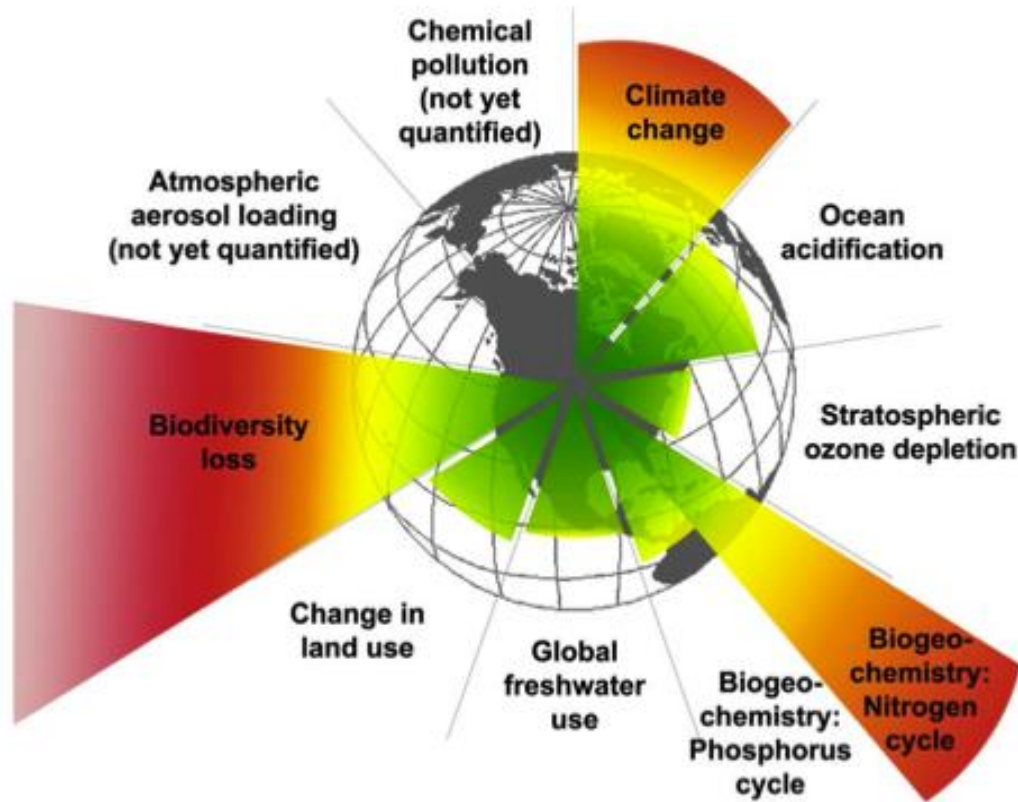


Map created by Benjamin D. Hennig
in collaboration with Globaia.org

www.viewsoftheworld.net

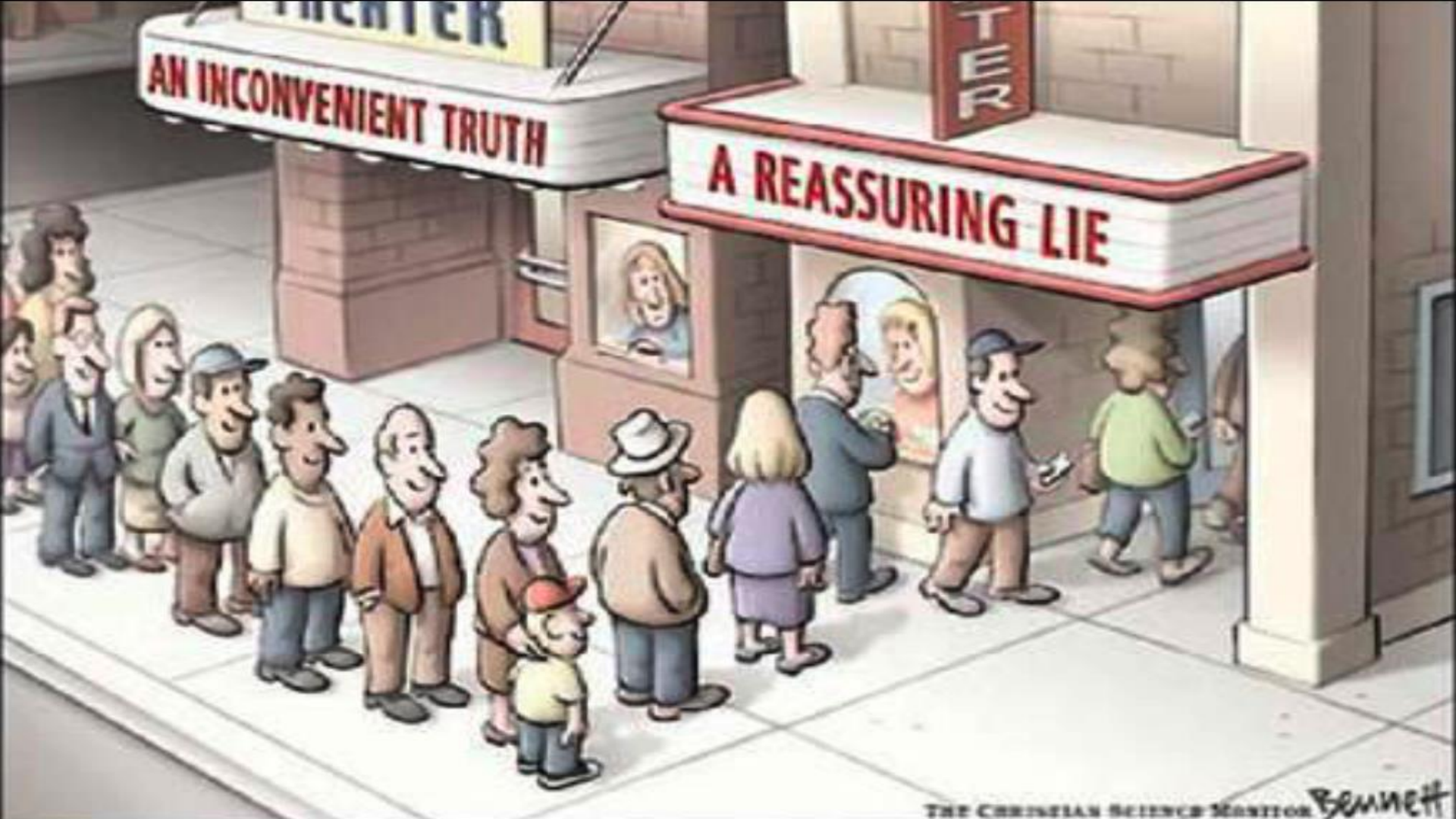
Mapping the
Anthropocene

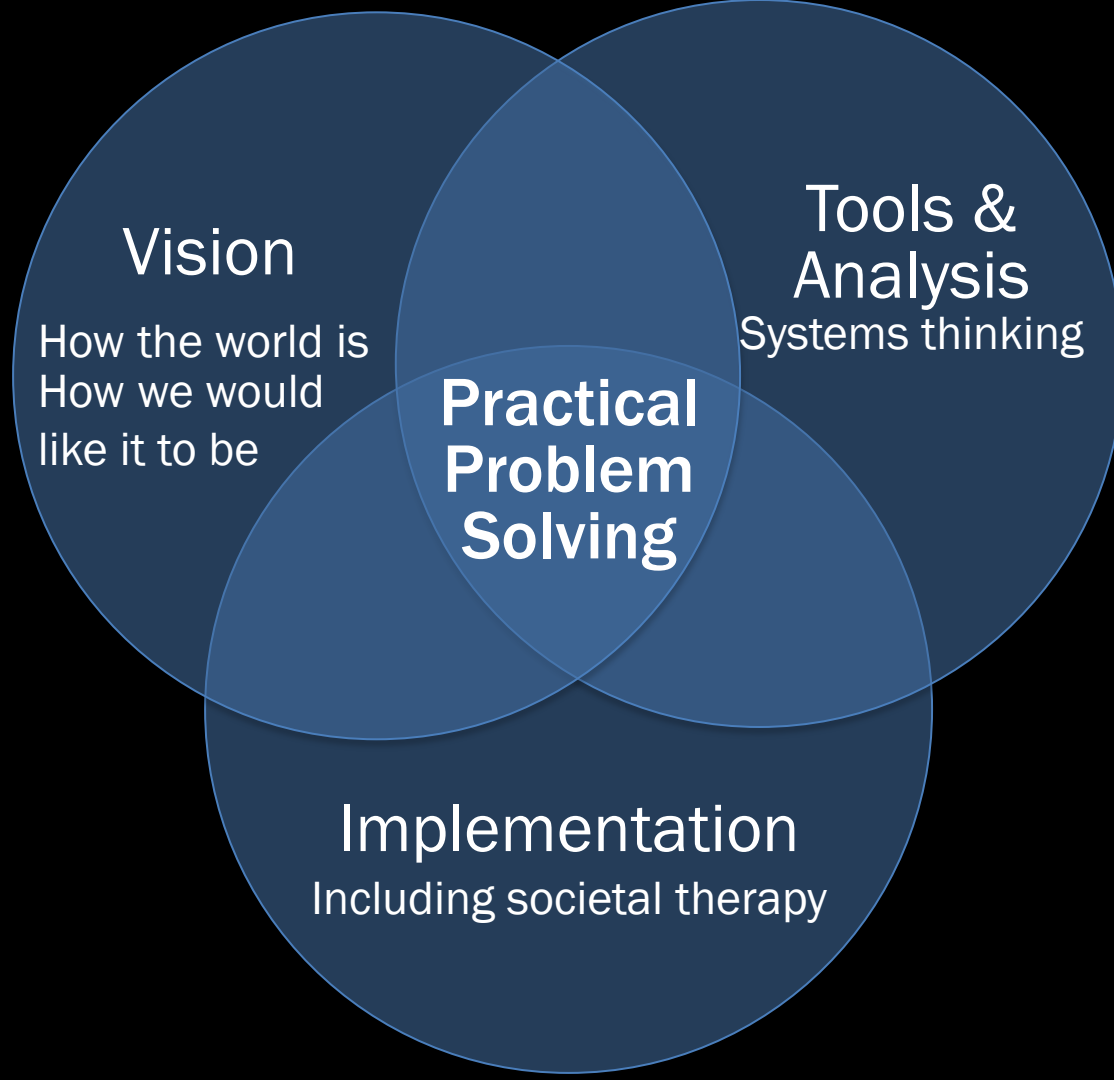
PLANETARY BOUNDARIES: THERE ARE FUNDAMENTAL *ECOLOGICAL* CONSTRAINTS



Rockström, J., et al. 2009.
A safe operating space for
humanity. *Nature* 461:472-
475

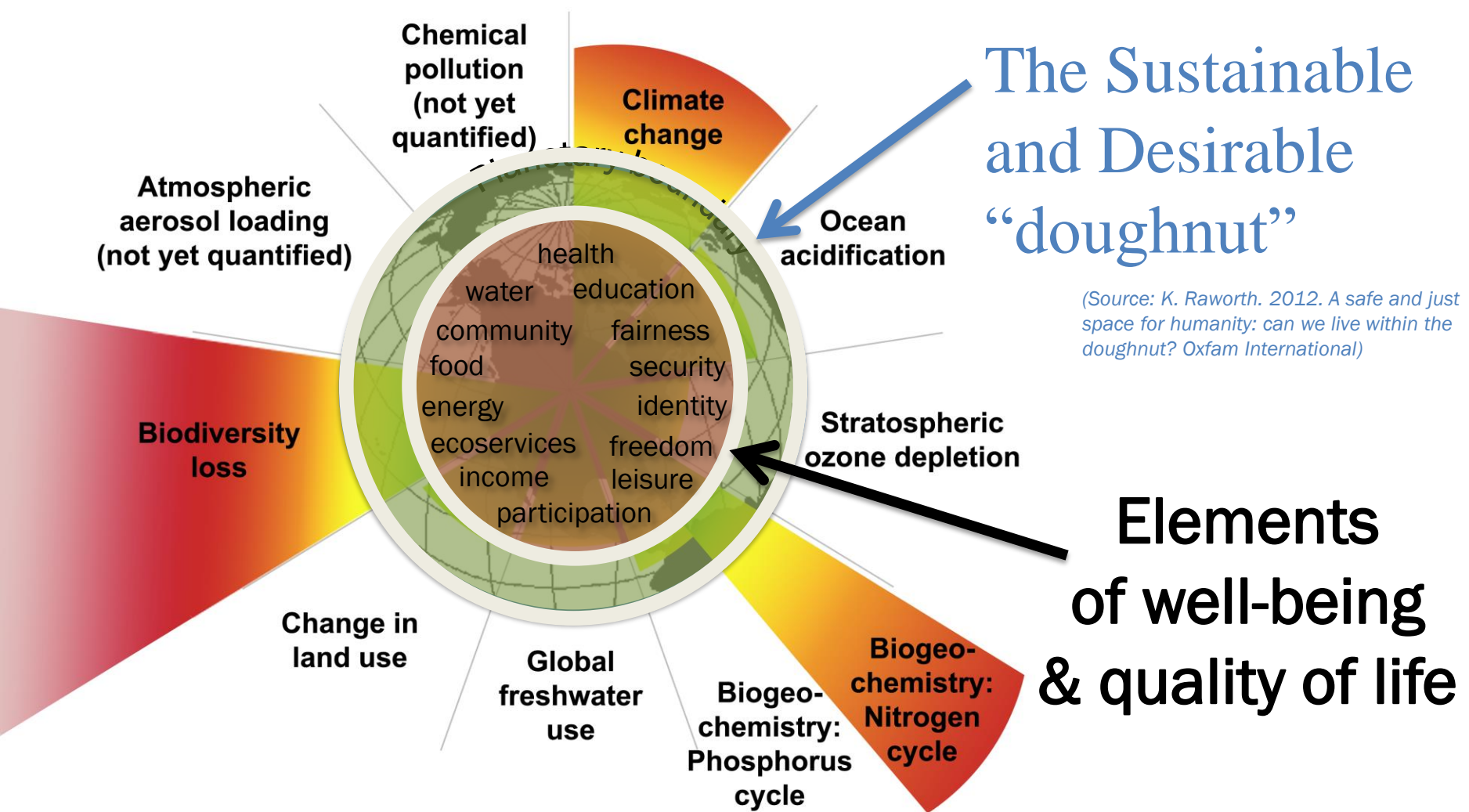
Steffen, W., J. Rockström,
and R. Costanza. 2011.
How Defining Planetary
Boundaries Can Transform
Our Approach to Growth.
Solutions. Vol 2, No. 3, May
2011





The Sustainable and Desirable “doughnut”

(Source: K. Raworth. 2012. *A safe and just space for humanity: can we live within the doughnut?* Oxfam International)



UN Sustainable Development Goals (SDGs)
TRANSFORMING OUR WORLD:
THE 2030 AGENDA FOR SUSTAINABLE DEVELOPMENT



Costanza, R., J. McGlade, H. Lovins, and I. Kubiszewski. 2014.
An Overarching Goal for the UN Sustainable Development Goals.
Solutions 5(4):13-16. <http://thesolutionsjournal.com/node/237220>

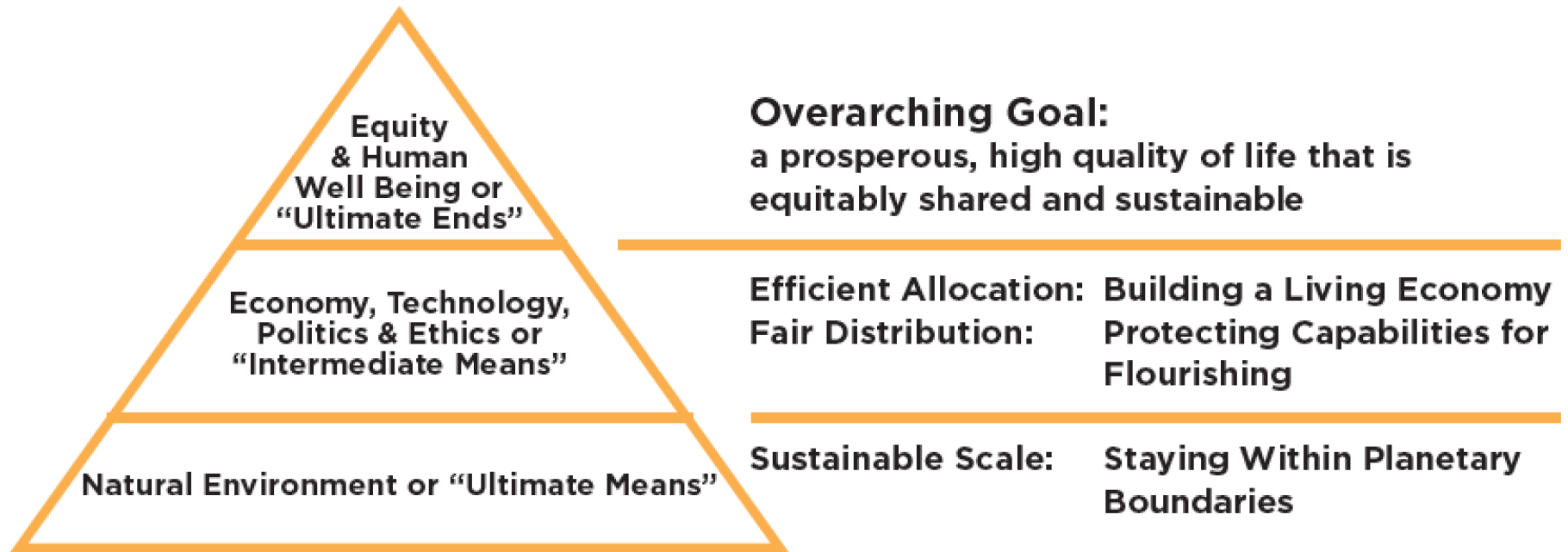


Figure 1. A hierarchy of goals along the Ends-Means spectrum⁹

An Introduction to
Ecological Economics Second Edition

Integrated Questions/Goals:

- Ecologically Sustainable Scale
- Socially Fair Distribution
- Economically Efficient Allocation

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An Introduction to Ecological Economics Second Edition

Costanza | Cumberland | Daly | Goodland
Norgaard | Kubiszewski | Franco

Second Edition

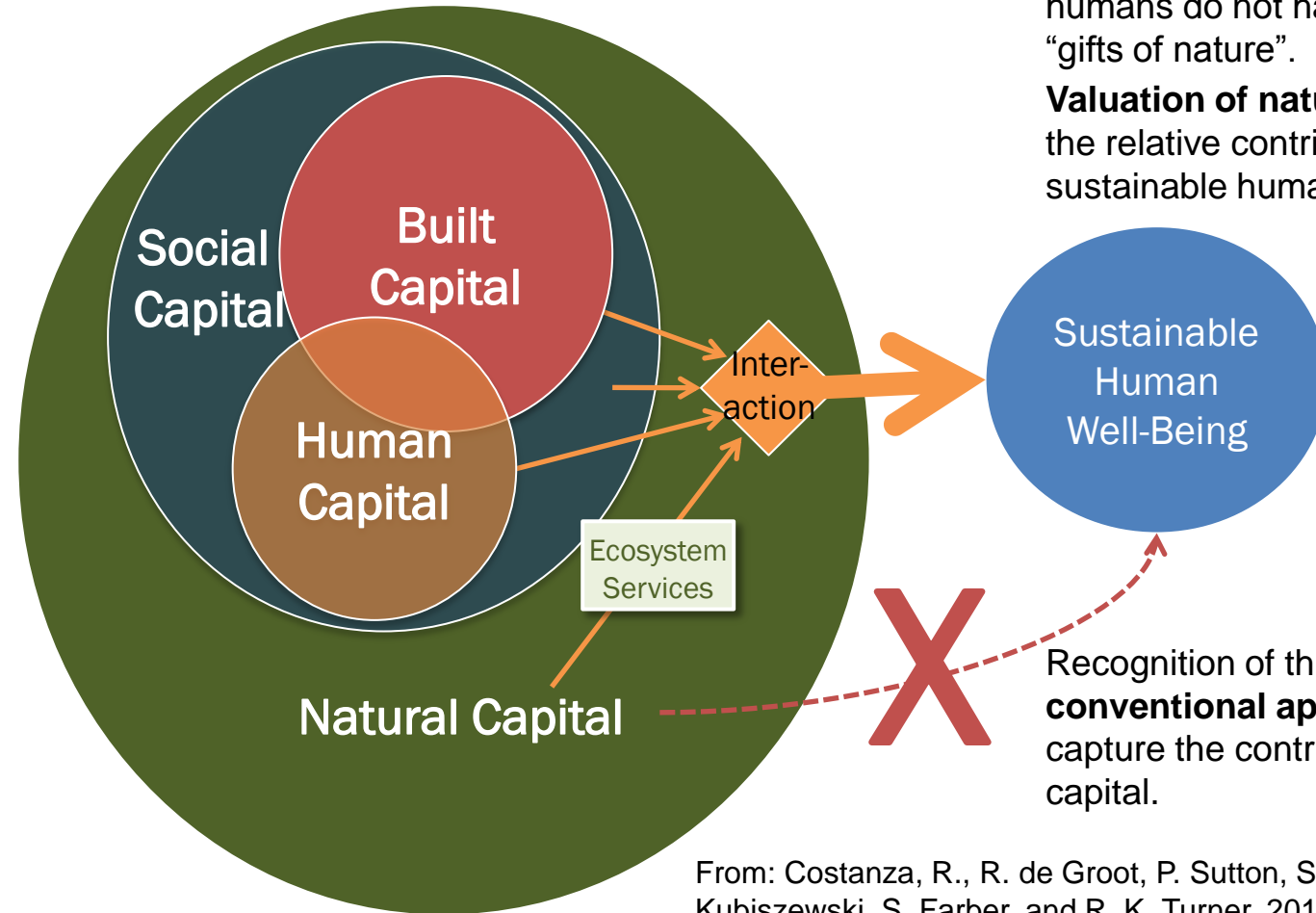
An Introduction to
Ecological Economics

Robert Costanza
John H. Cumberland
Herman Daly
Robert Goodland
Richard B. Norgaard
Ida Kubiszewski
Carol Franco

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Natural Capital is everything in the world that humans do not have to produce or maintain – the “gifts of nature”.

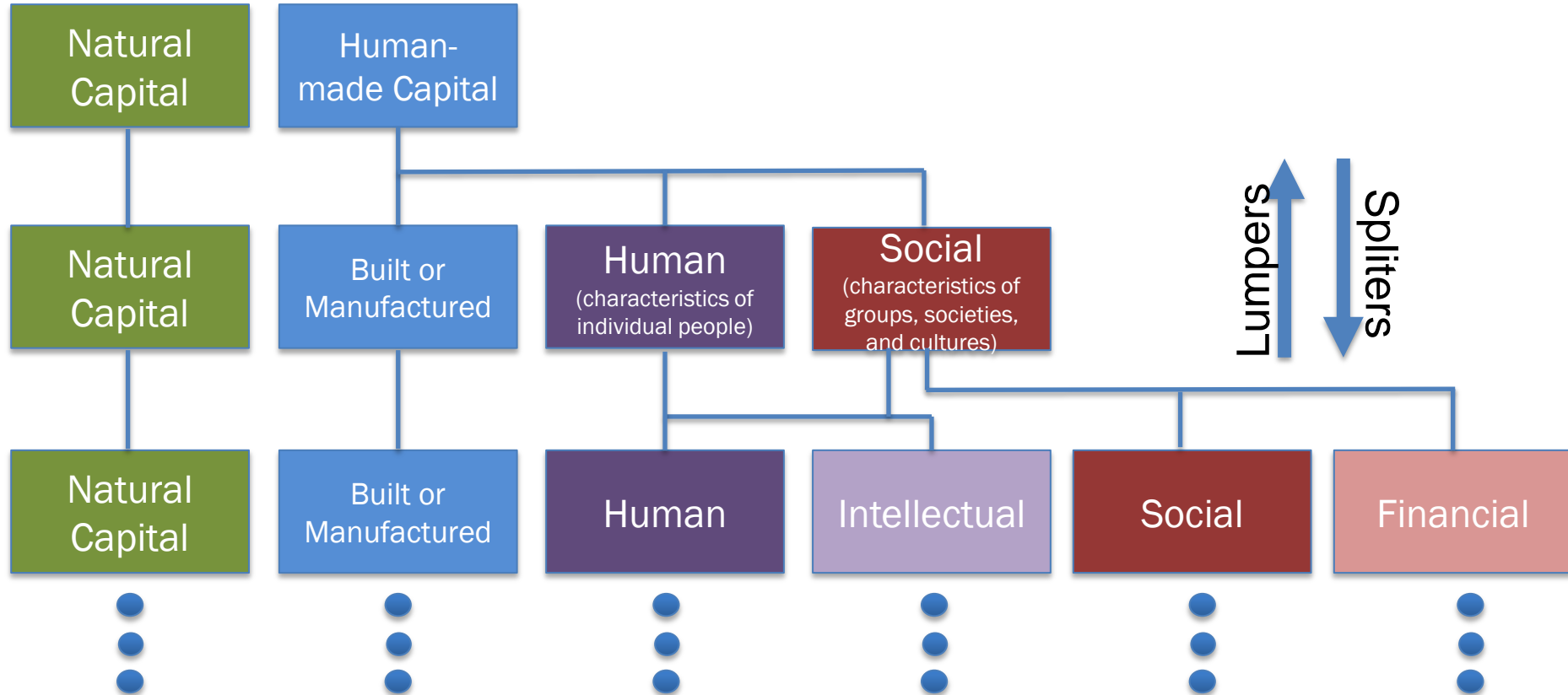
Valuation of natural capital is about assessing the relative contributions of natural capital to sustainable human well-being.

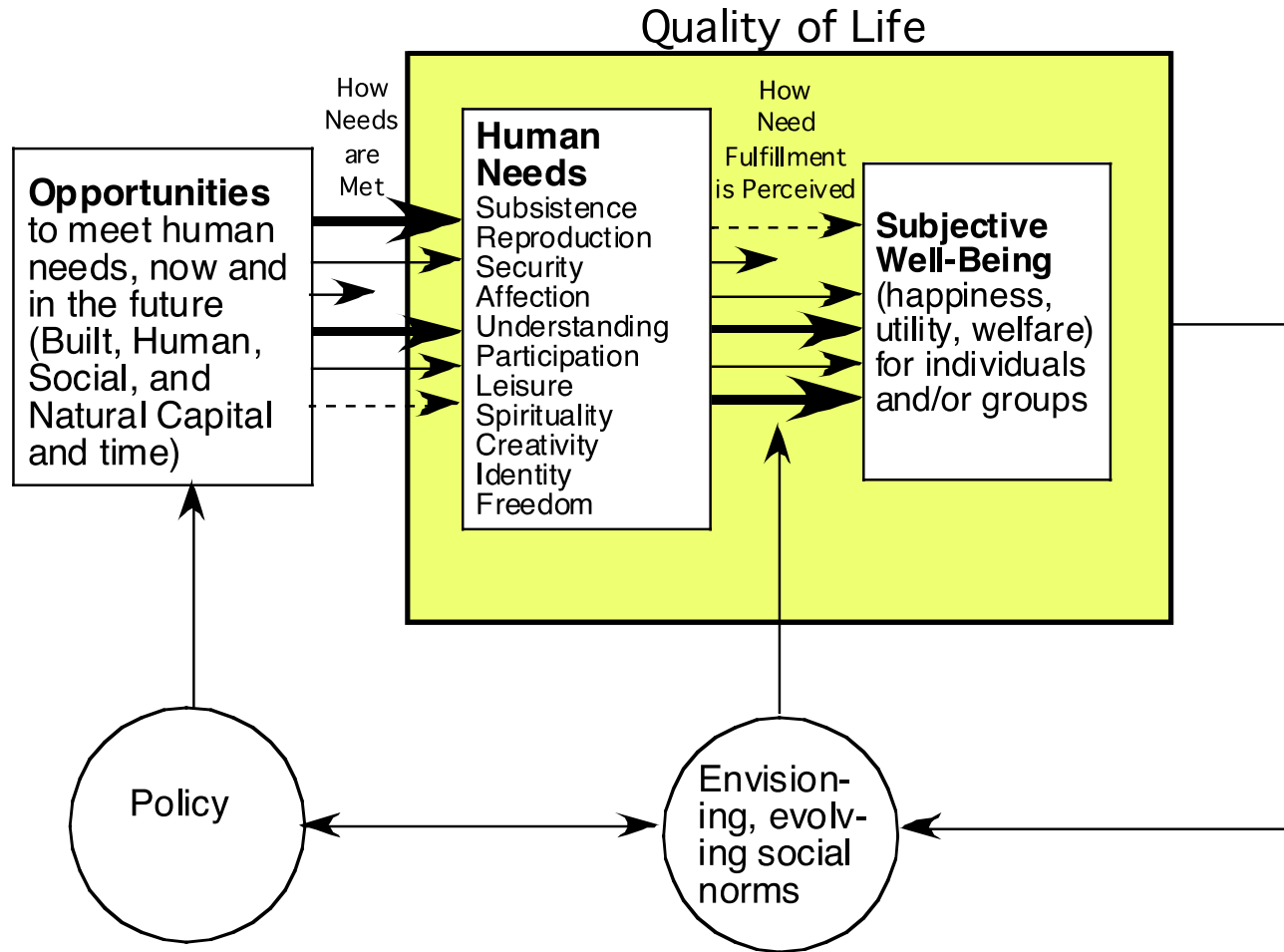


Recognition of this is **different from conventional approaches** that do not adequately capture the contributions of natural and social capital.

From: Costanza, R., R. de Groot, P. Sutton, S. van der Ploeg, S. Anderson, I. Kubiszewski, S. Farber, and R. K. Turner. 2014. Changes in the global value of ecosystem services. *Global Environmental Change* 26:152-158.

Taxonomies of Capital Assets





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. 2007. Quality of Life: An Approach Integrating Opportunities, Human Needs, and Subjective Well-Being. *Ecological Economics* 61: 267-276

Positive Psychology

PERMA: Well-being has five measurable elements that count toward it

- **P**ositive Emotion (of which happiness and life satisfaction are aspects)
- **E**ngagement (being in flow, being one with the music)
- Good **R**elationships (social capital)
- **M**eaning and Purpose (belonging to and serving something you believe is bigger than you are)
- **A**ccomplishment, Achievement, and Mastery



Martin Seligman
Zellerbach Family
Professor of Psychology,
University of
Pennsylvania



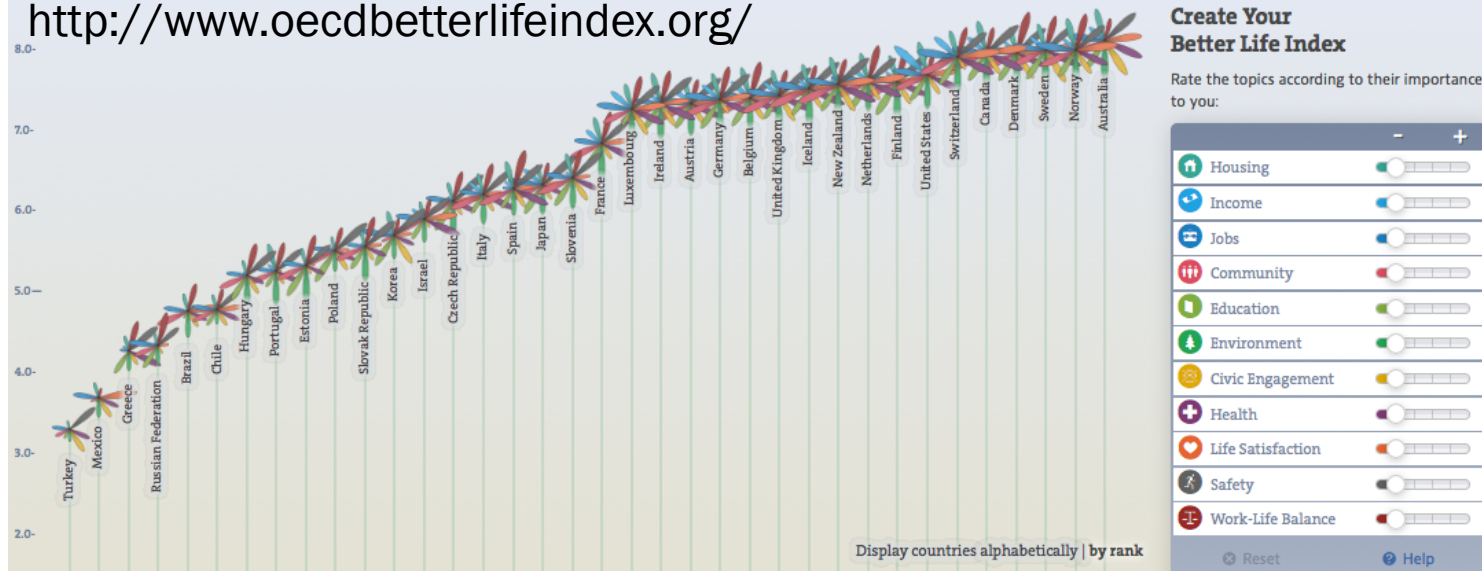
Time to leave GDP behind

Gross domestic product is a misleading measure of national success. Countries should act now to embrace new metrics, urge **Robert Costanza** and colleagues.

Table 1. Some alternative National Indicators of Welfare and Well-Being.

Indicator	Type	Units	Domains	Indicators	Explanation	Area coverage	Temporal Coverage	References	Website
Index of Sustainable Economic Welfare (ISEW) and Genuine Progress Indicator (GPI)	GDP modification	\$	4	26	Personal Consumption Expenditures weighted by income distribution, with volunteer and household work added and environmental and social costs subtracted.	17 countries, several states and regions	1950-various	1-3	http://genuineprogress.net/
Genuine Savings	Income accounts modification	\$	3	5	level of saving after depreciation of produced capital; investments in human capital ; depletion of minerals, energy, and forests; and damages from local and global air pollutants are accounted for	140 countries	1970-2008	4,5	http://web.worldbank.org/WBSITE/EXTERNAL/TORICS/ENVIRONMENT/EXTTEEI/0,,contentMDK:20502388~menuPK:1187778~pagePK:148956~piPK:216618~theSitePK:408050,00.html
Inclusive Wealth Index	Capital accounts modification	\$	4	8	Asset wealth including, built, human, and natural resources	20 countries	1990-2008	6	http://www.ihdp.unu.edu/article/iwr
Australian Unity Well-Being Index	Survey-based index	Index #	14	14	Annual survey of various aspects of well-being and quality of life	Australia	2001-present	7	http://www.deakin.edu.au/research/acqol/auwbi/index.php
World Values Survey	Survey-based index	Index #	10	100's	Periodic (5 "waves" so far) survey of a broad range of variables. Most used for international comparisons is ranking of "how satisfied are you with your life?" question.	73 countries	1981-2008 intermittent	8,9	http://www.wvsevsdb.com
Gallup-Healthways Well-Being Index	Survey-based index	Index #	6	39	Annual survey in six domains: live evaluation, physical health, emotional health, healthy behavior, work environment, and basic assets	50 states in US	2008-present	10	http://www.well-beingindex.com/
Gross National Happiness	Survey-based index	Index #	9	33	Detailed in-person survey around nine domains: psychological well-being, standard of living, governance, health, education, community vitality, cultural diversity, time use, and ecological diversity	Bhutan	2010	11	
Human Development Index (HDI)	Composit Index	Index #	3	4	Index of GDP/person, spending on health and education, and life expectancy	177 countries	1980-present	12	http://hdr.undp.org/en/
Happy Planet Index	Composit Index	Index #	3	3	HPI = subjective well being * life expectancy / ecological footprint	153 countries	3 yrs	13,14	http://www.happyplanetindex.org/
Canadian Index of Well-Being	Composit Index	Index #	8	80	Includes community vitality, democratic engagement, education, environment, population, leisure, living standards, and time use	Canada	1994-present	15	https://uwaterloo.ca/canadian-index-wellbeing/
National Well-Being Index	Composit Index	Index #	5	5	proxies for built, human, natural and social capital with weights based on regression with subjective well-being	56 countries	1 yr	16,17	
OECD Better Life Index	Composit Index	Index #	11	25	Includes housing, income, jobs community education, environment, civic engagement, health, life satisfaction, safety, and work-life balance	36 OECD countries	1 yr	18,19	http://www.oecdbetterlifeindex.org
Well-Being of Nations	Composit Index	Index #	20	63	63 indicators in 20 domains weighted and ranked	180 countries	1990-2000	20	http://sedac.ciesin.columbia.edu/data/set/cesic-wellbeing-of-nations
Sustainable Society Index	Composit Index	Index #	5	22	22 indicators in 5 domains ranked with various weightings	150 countries	2 yrs	21	http://www.ssindex.com/

<http://www.oecdbetterlifeindex.org/>



Create Your Better Life Index

Rate the topics according to their importance to you:

	-	+
Housing	<input type="range"/>	<input type="range"/>
Income	<input type="range"/>	<input type="range"/>
Jobs	<input type="range"/>	<input type="range"/>
Community	<input type="range"/>	<input type="range"/>
Education	<input type="range"/>	<input type="range"/>
Environment	<input type="range"/>	<input type="range"/>
Civic Engagement	<input type="range"/>	<input type="range"/>
Health	<input type="range"/>	<input type="range"/>
Life Satisfaction	<input type="range"/>	<input type="range"/>
Safety	<input type="range"/>	<input type="range"/>
Work-Life Balance	<input type="range"/>	<input type="range"/>

[Reset](#) [Help](#)

[Gender differences](#)

[Compare with others](#)

[Share your index](#)

How's life?

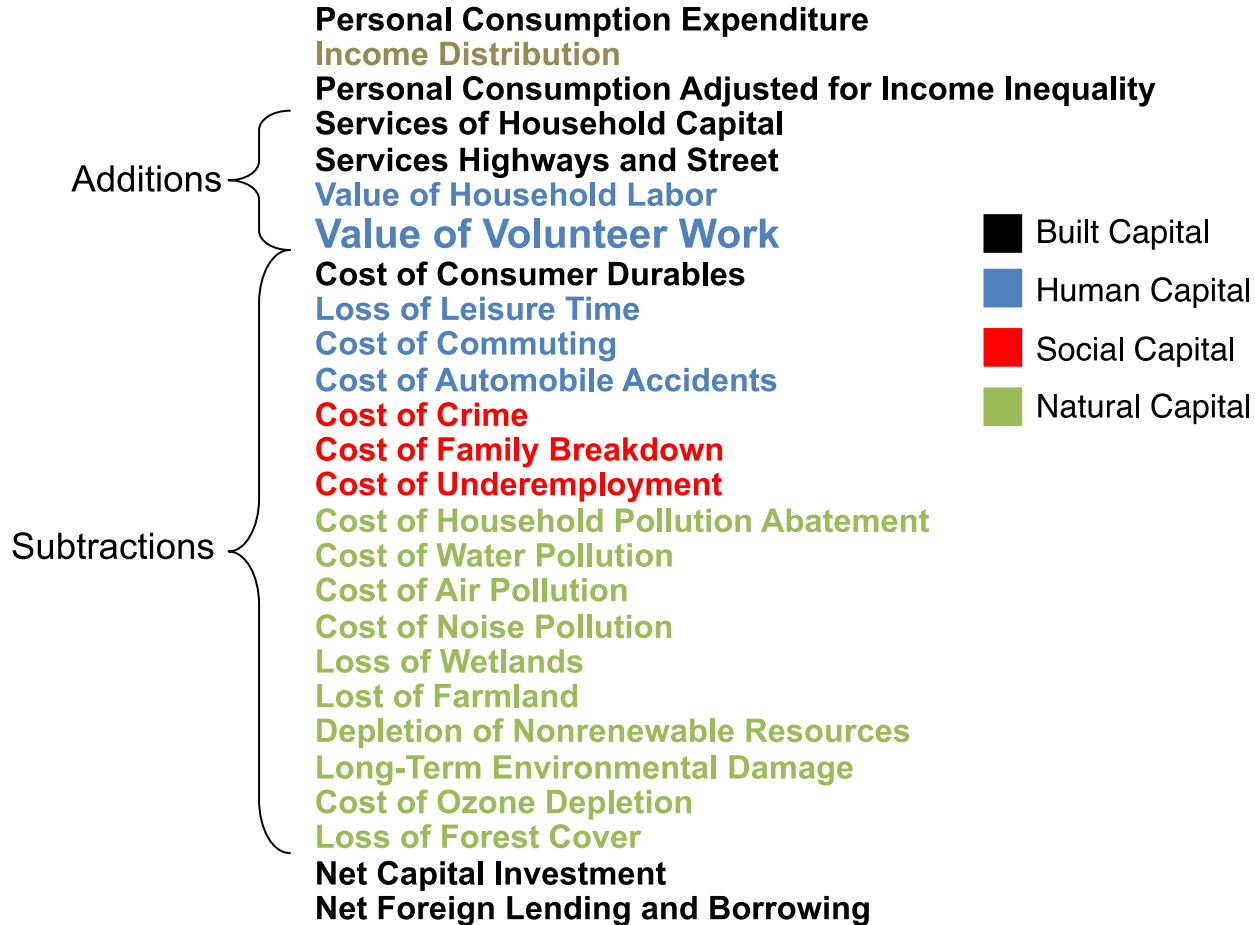
There is more to life than the cold numbers of GDP and economic statistics – This Index allows you to compare well-being across countries, based on 11 topics the OECD has identified as essential, in the areas of material living conditions and quality of life.

Mapping well-being

What matters most to people around the world?

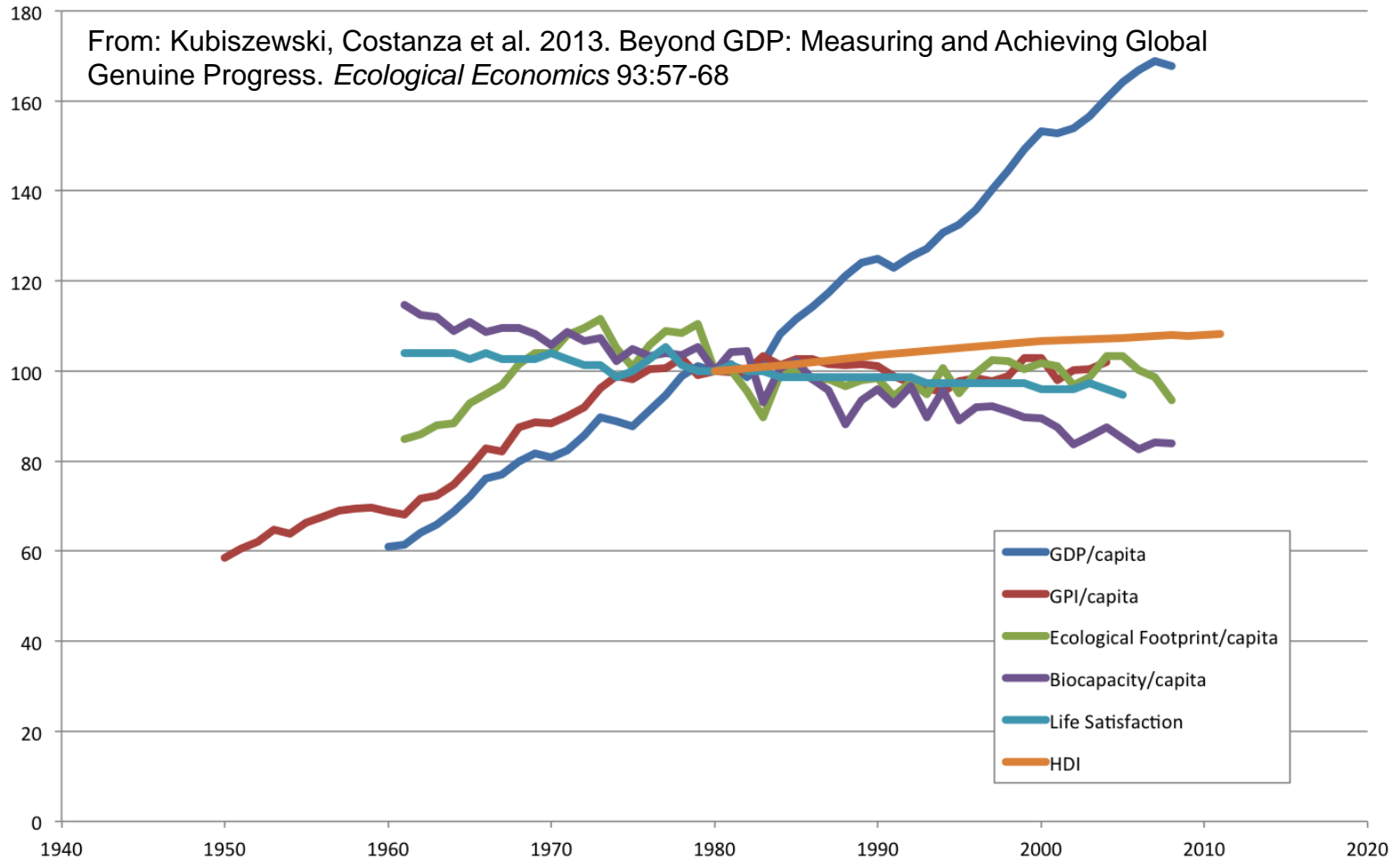


Genuine Progress Indicator (or ISEW) by Component



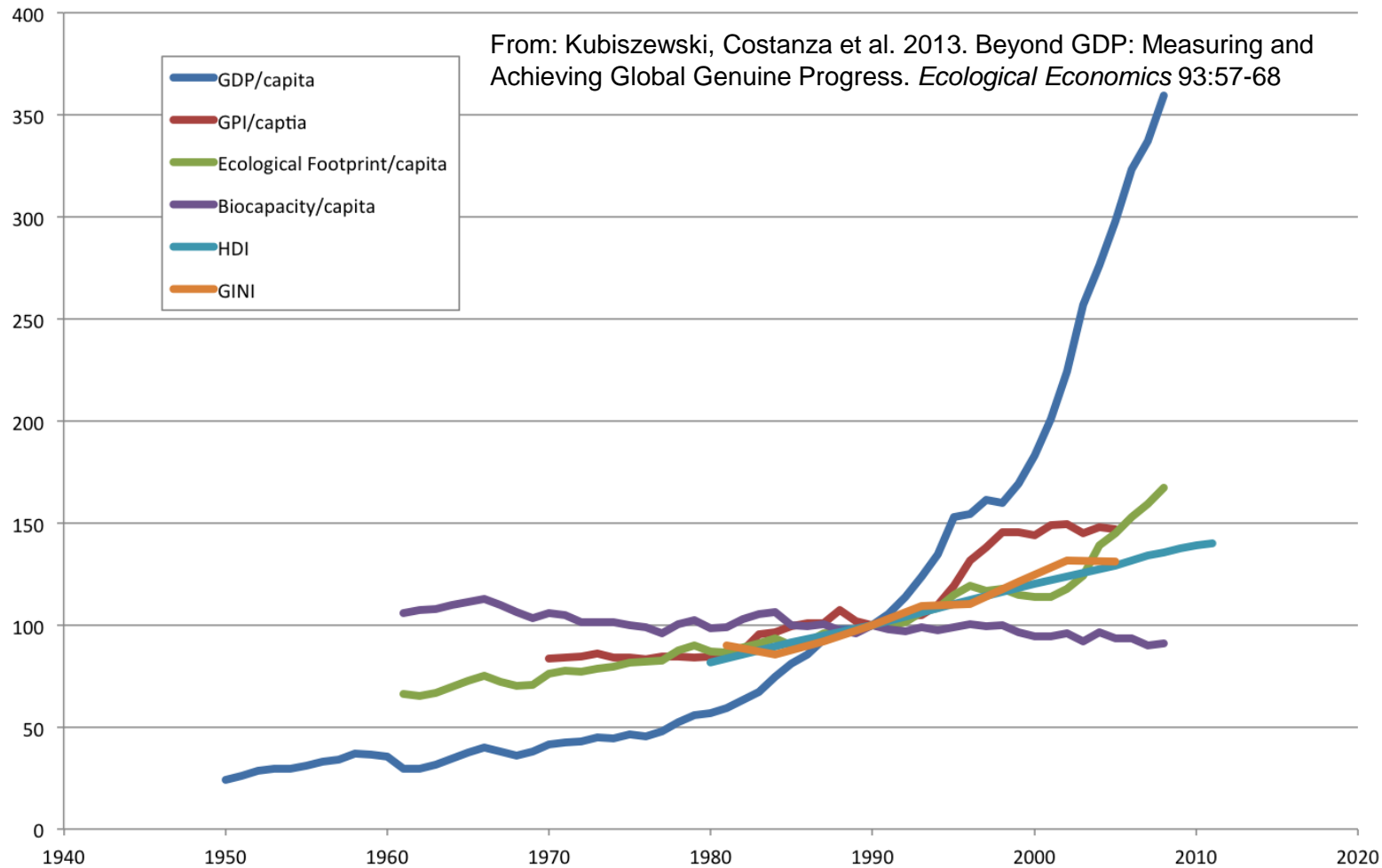
United States

From: Kubiszewski, Costanza et al. 2013. Beyond GDP: Measuring and Achieving Global Genuine Progress. *Ecological Economics* 93:57-68



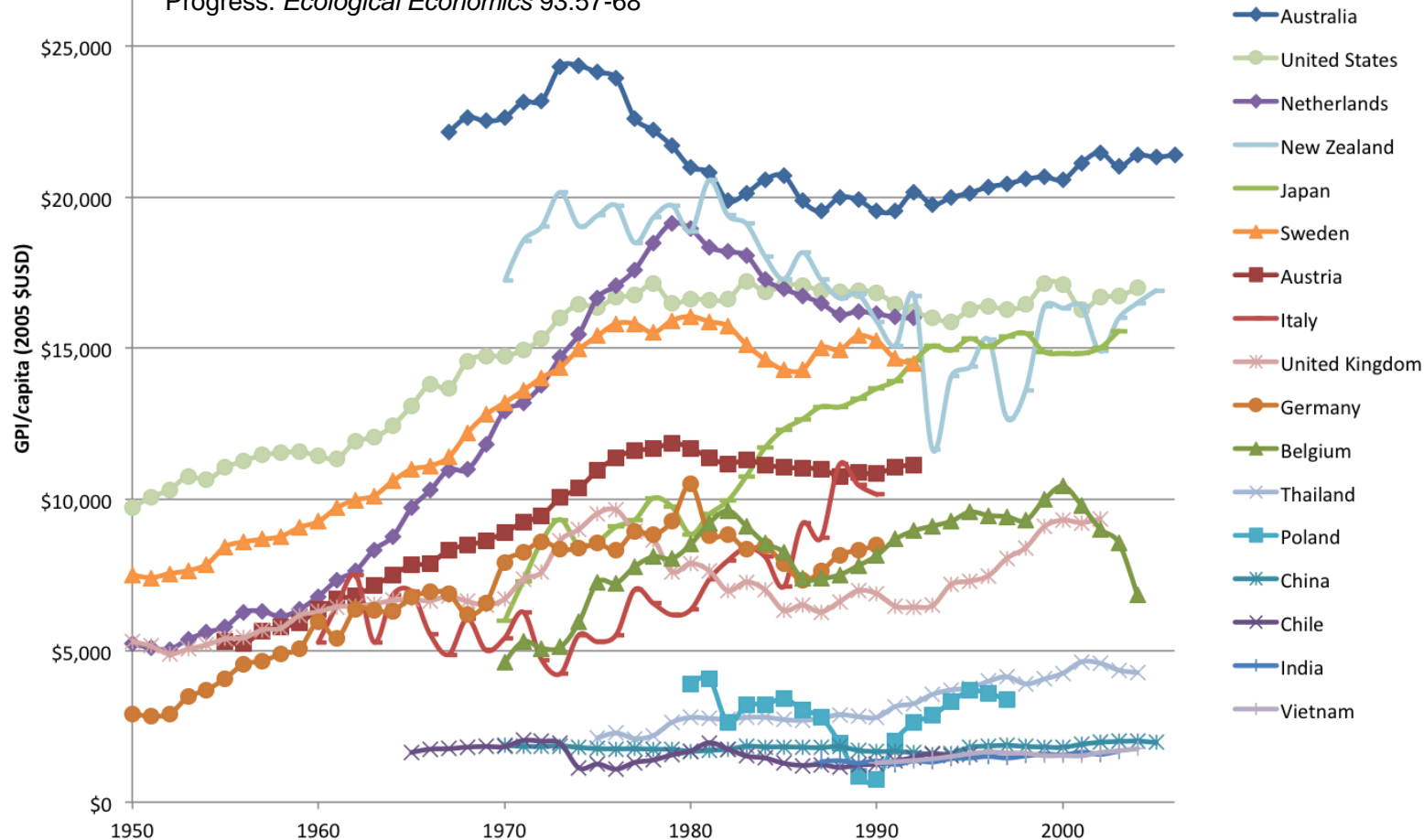
China

From: Kubiszewski, Costanza et al. 2013. Beyond GDP: Measuring and Achieving Global Genuine Progress. *Ecological Economics* 93:57-68

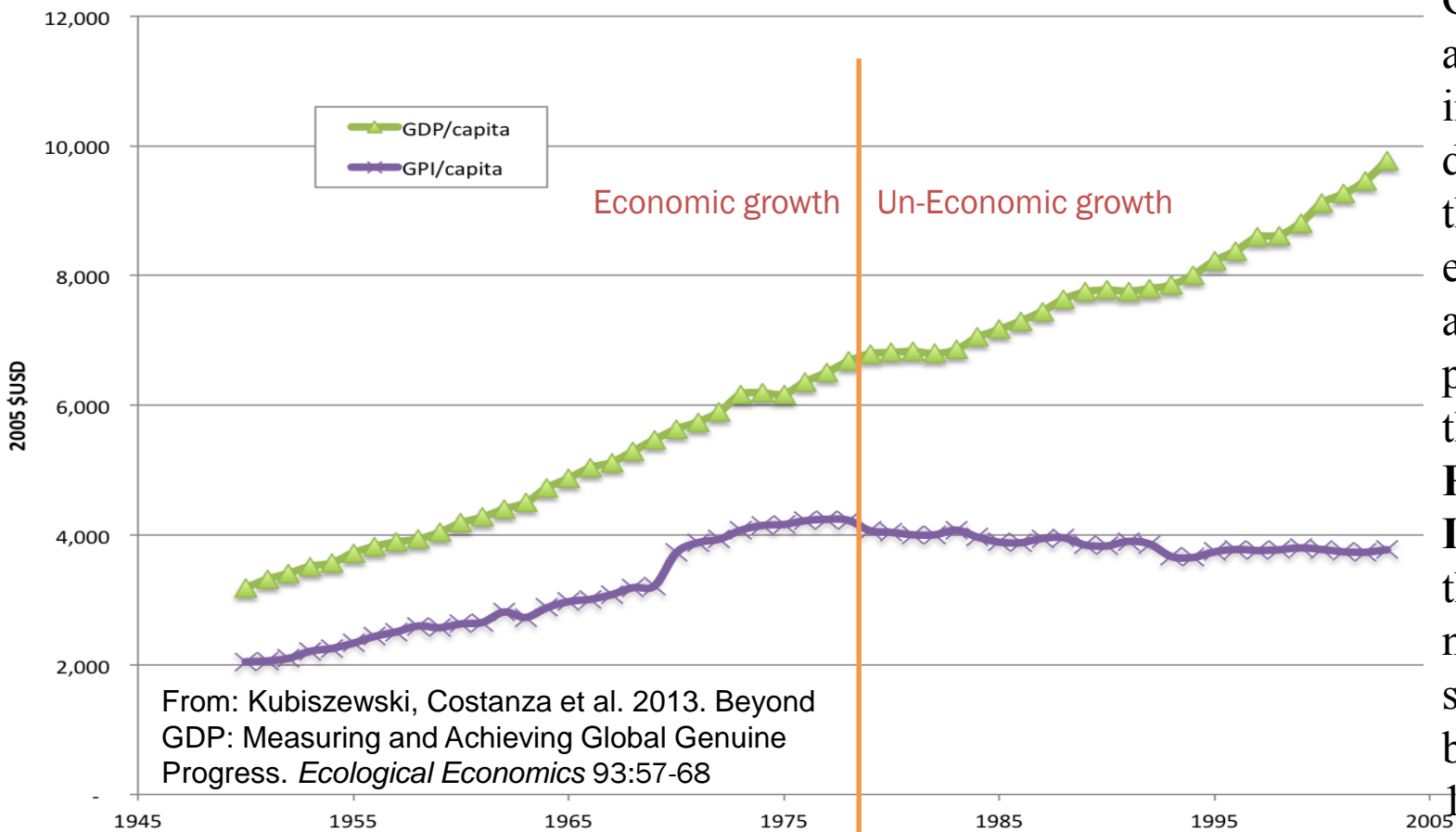


GPI /capita for the 17 countries for which it has been estimated

From: Kubiszewski, Costanza et al. 2013. Beyond GDP: Measuring and Achieving Global Genuine Progress. *Ecological Economics* 93:57-68



Global GPI/capita & GDP/capita



When GDP/capita is adjusted for income distribution and the costs of environmental and social problems using the **Genuine Progress Indicator (GPI)** there has been no real growth in societal well-being since 1980.

GENERAL INFORMATION

What is the Genuine Progress Indicator?

What Are The Gross Domestic/State Products?

Genuine Progress Indicator Benefits

What Are Other States Doing?

MD-GPI Background & Methodology

Other Indicators Of Social Well-Being



Maryland's Genuine Progress Indicator

An Index for Sustainable Prosperity

www.dnr.maryland.gov/mdgpi/

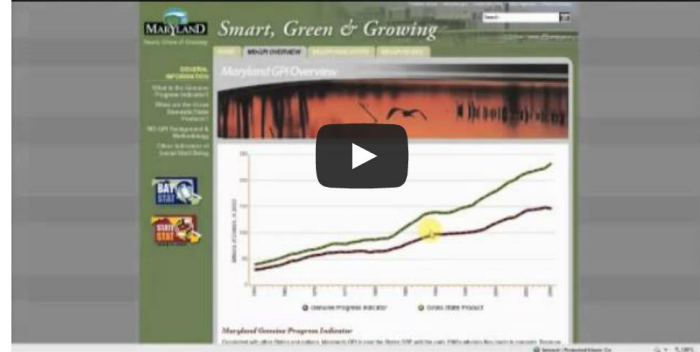
Wealth vs. Well-Being: How Do We Measure Prosperity?

Maryland developed its Genuine Progress Indicator to measure how development activities impact long-term prosperity, both positively and negatively. Here in Maryland and across the globe, people are continually challenged by the need to find a balance between advancing economic gain and ensuring social well-being.

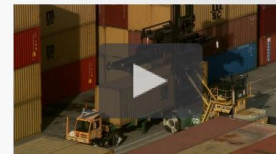
Traditional indicators like the Gross Domestic/State Products address only economic transactions. They do not include the environmental and social costs of what we buy, the quality of life impacts of how we live, or fully appreciate the significant contributions of our natural systems.

We invite you to learn how we developed our GPI, find out how Maryland is doing in 26 different indicators, and explore a model to see how policy decisions made today may affect future generations.

Maryland Genuine Progress Indicator Tutorial



MD GPI on PBS Newshour



MD-GPI News

- Beyond GDP: US States Have Adopted Genuine Progress Indicators
- Baltimore's Genuine Progress Indicator Shows Healthy Economic Growth
- Implementing GPI in Vermont, Maryland and Oregon
- Forget the GDP. Some States Have Found a Better Way to Measure Our Progress
- Time to leave GDP behind
- Maryland Continues to Lead the Nation in Genuine Progress Tracking

[More News & Reports](#)

Contact Information

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We need a new Bretton Woods





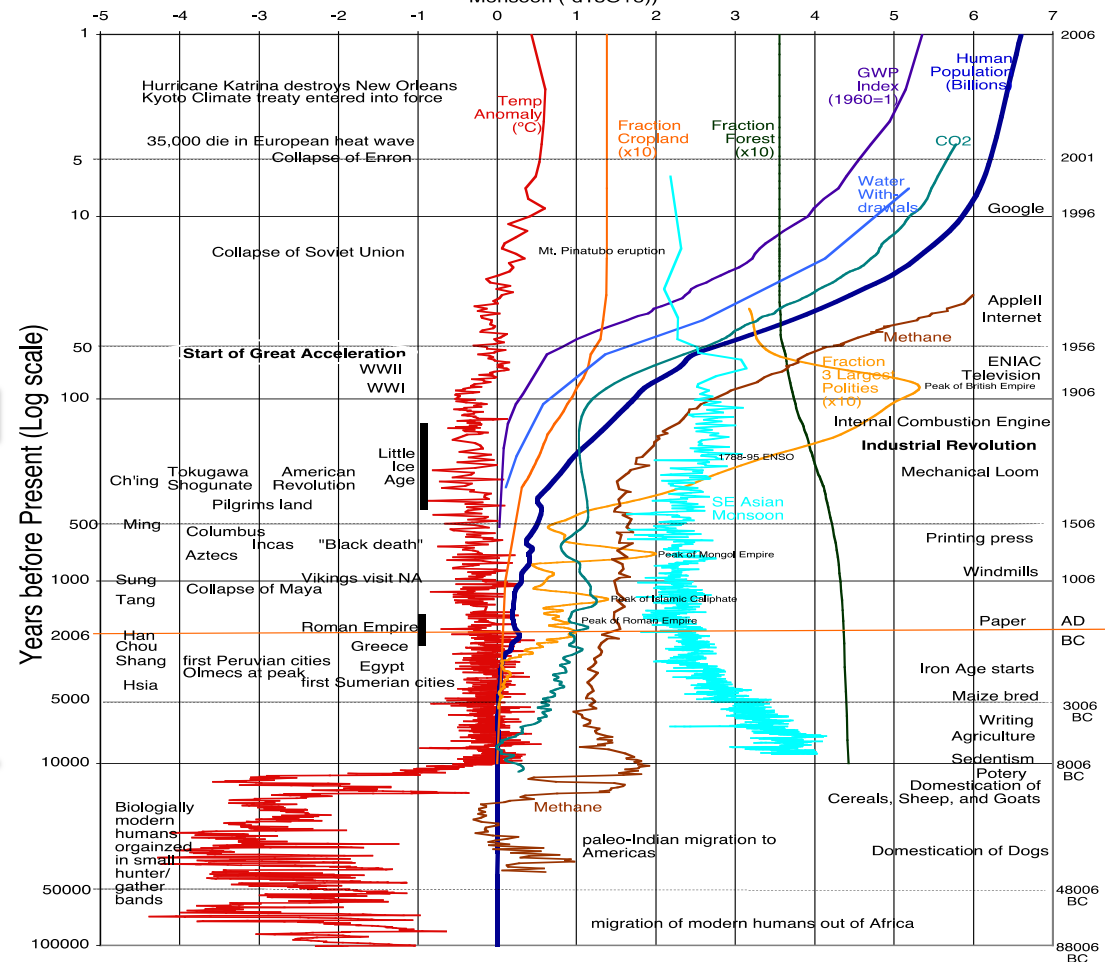
Can humanity make the
transition to a sustainable *and*
desirable future without a
major collapse?

Temperature Anomaly (°C) Human Population (billions) GWP index (1960=1) Fraction land (x10) Water Withdrawals (1000km³) CO₂ (d260ppm/20) Methane (d400ppb/180) SE Asian Monsoon (-d180+5)

Anthropocene

Holocene

Pleistocene



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

SCIENTIFIC
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When the Sea Saved Humanity

CURTIS W. MAREAN

Shortly after Homo sapiens arose, harsh climate conditions nearly extinguished our species. Recent finds suggest that the small population that gave rise to all humans alive today survived by exploiting a unique combination of resources along the southern coast of Africa

November 1, 2012



Population Density, Forest Condition, Settlement Trade Strength, and Soil Degradation for the Simulated Landscape at 800-Year Intervals

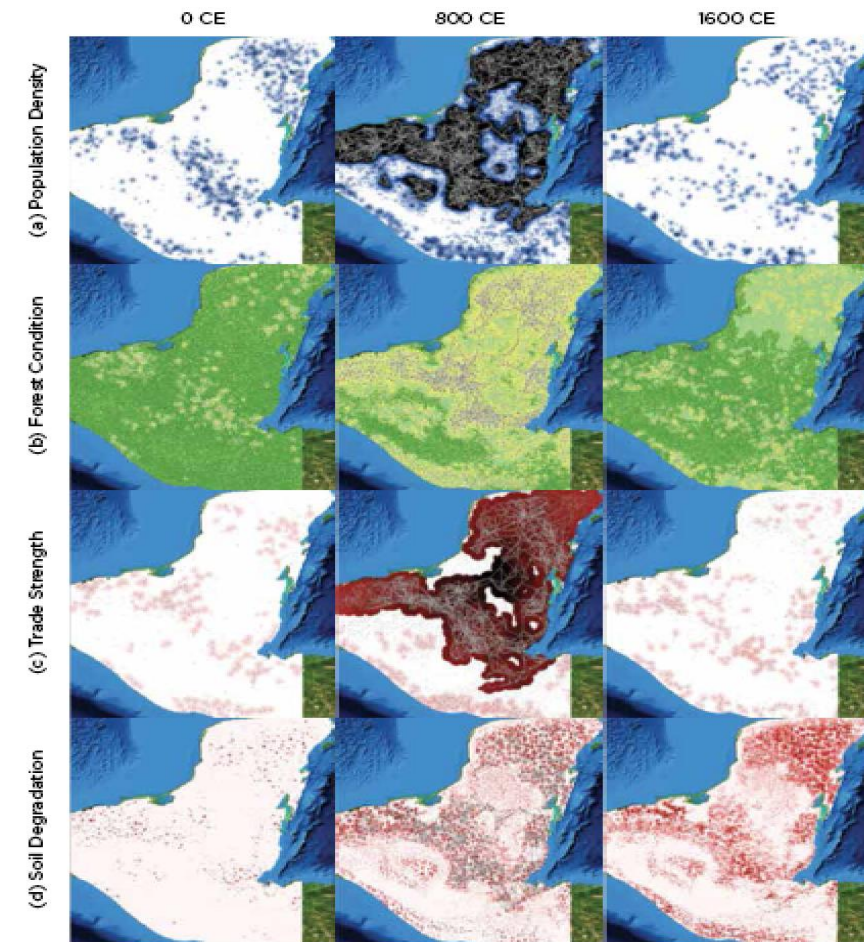


Figure 1. Darker colouring shows increased a) population density (blue), b) forest condition (three states of cleared/cropped cells) (yellow), secondary regrowth (light green) and climax forest (dark green), c) trade strength (red), and d) soil degradation (red).

Achieving Sustainable Societies: Lessons from Modelling the Ancient Maya

by Scott Heckbert, Robert Costanza, and Lael Parrott, *Solutions*, 5(5), 2014

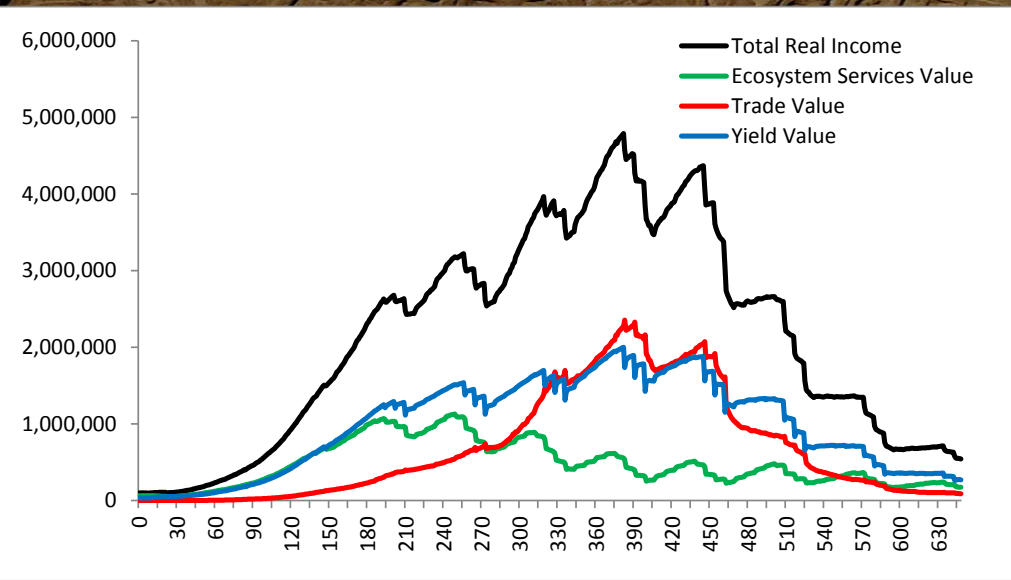
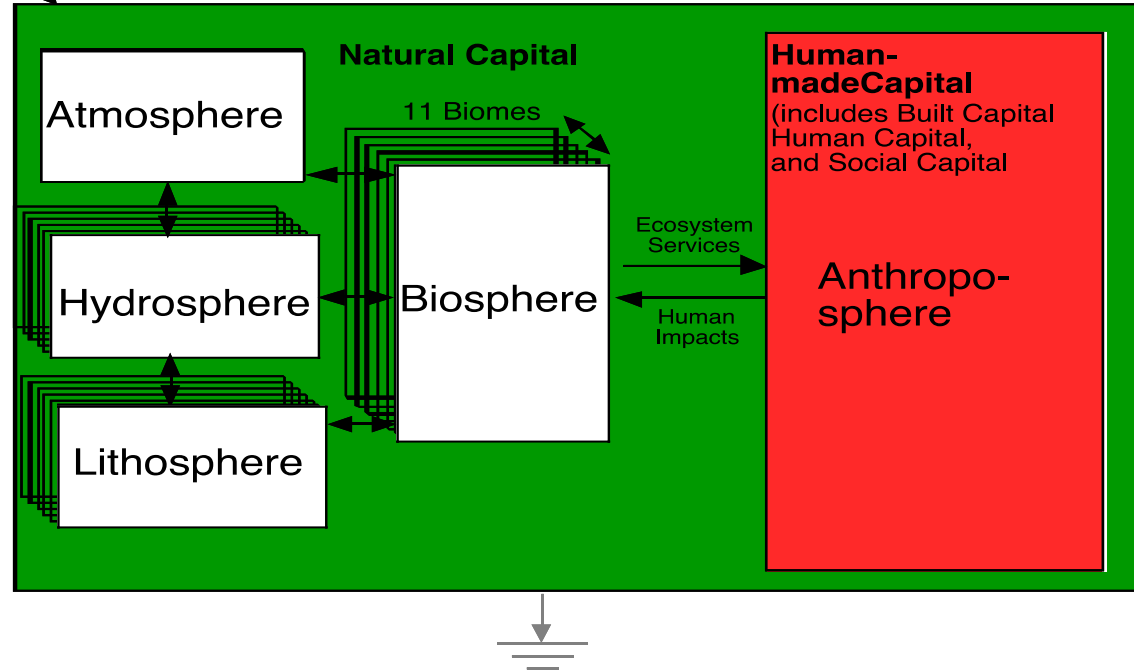


Figure 6: Real income of all simulated settlements over time by contributions from agriculture, ecosystem services, and trade value. Ecosystem services is eventually superceded by agriculture, and both by trade around time step 350.

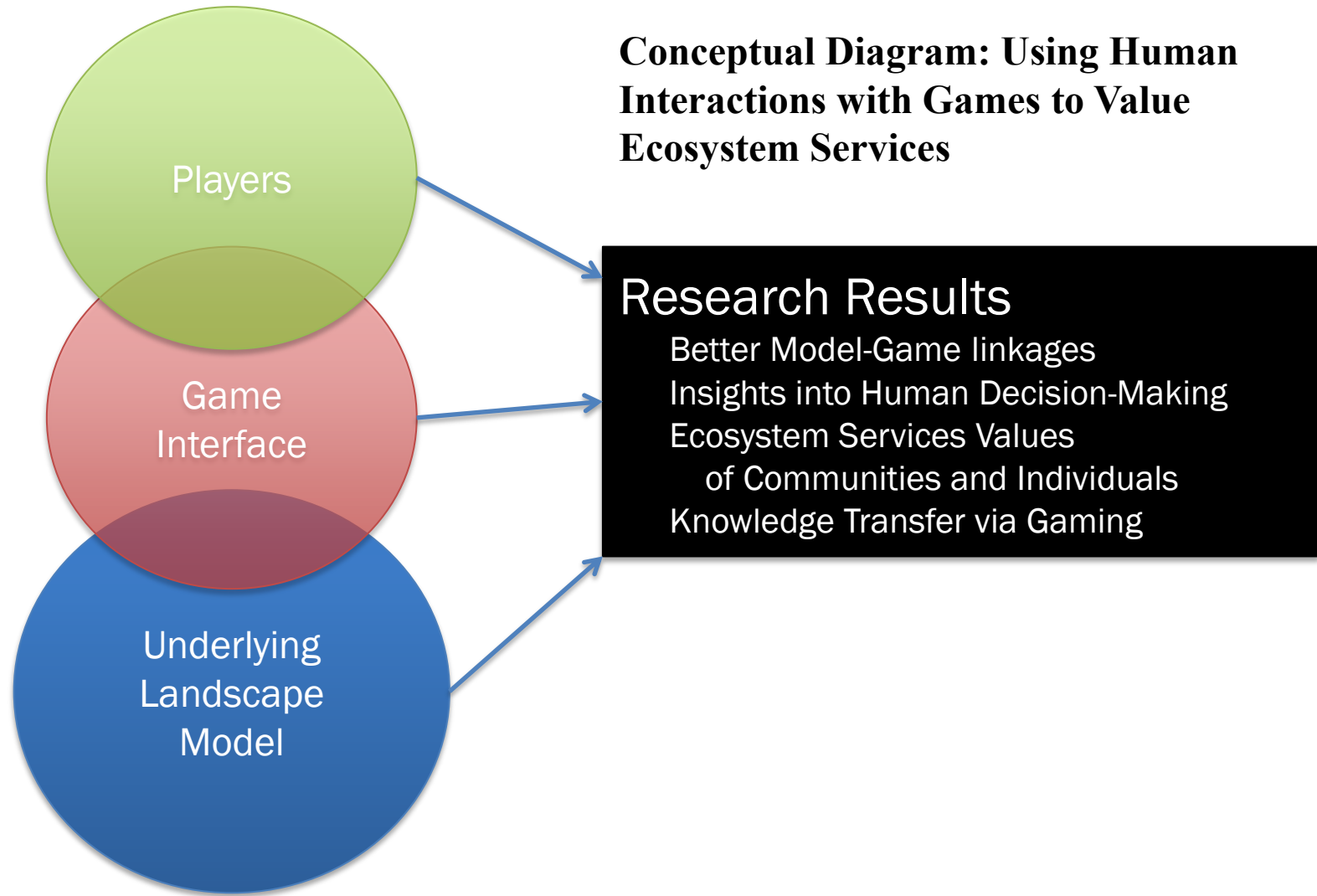
Solar
Energy

GUMBO (Global Unified Model of the BiOsphere)

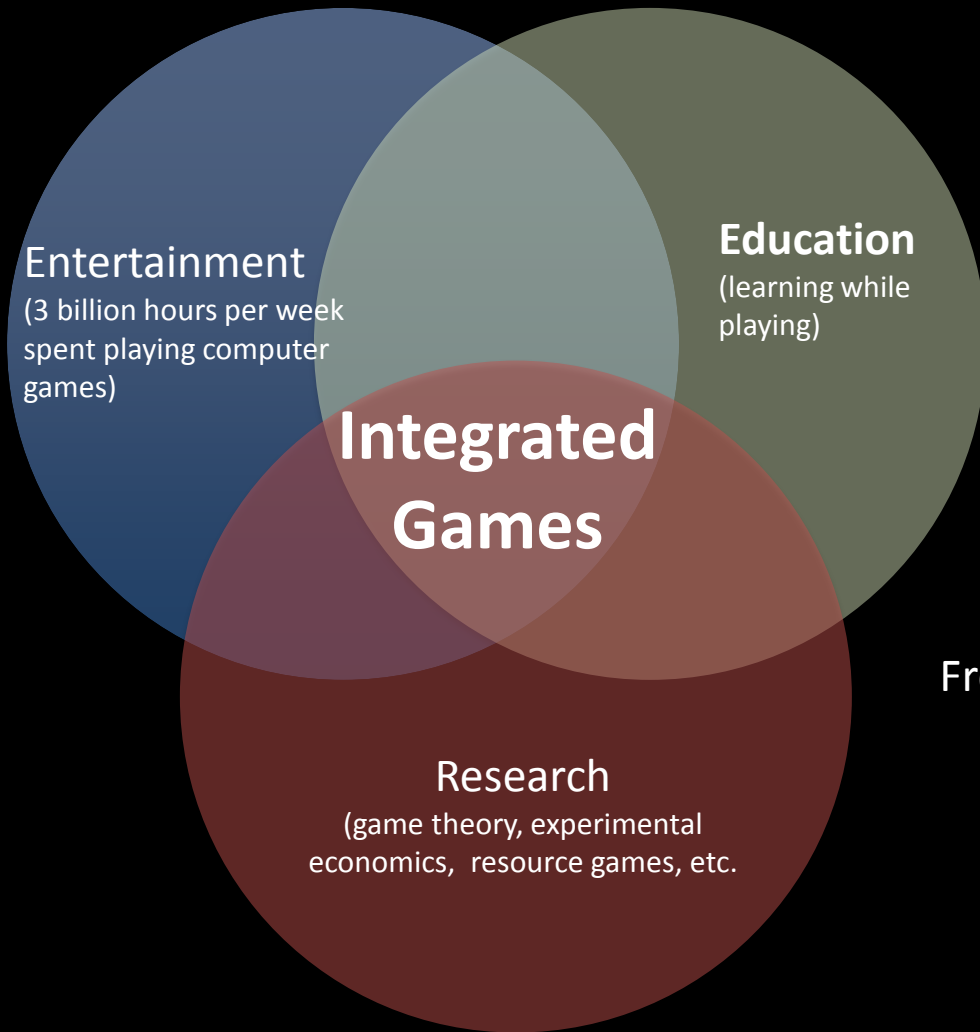


From: Boumans, R., R. Costanza, J. Farley, M. A. Wilson, R. Portela, J. Rotmans, F. Villa, and M. Grasso. 2002. Modeling the Dynamics of the Integrated Earth System and the Value of Global Ecosystem Services Using the GUMBO Model. *Ecological Economics* 41: 529-560

Conceptual Diagram: Using Human Interactions with Games to Value Ecosystem Services



Uses of Games



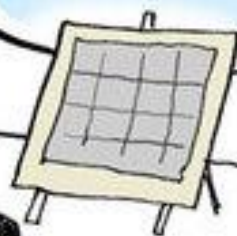
From: Costanza, R., et al. 2014.
Simulation games that integrate
research, entertainment, and
learning around ecosystem
services. *Ecosystem Services* 10:
195-201.



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.



Overcoming Societal Addictions: What Can We Learn From Individual Therapies?

Robert Costanza^{1*}, Paul Atkins² Mitzi Bolton¹, Steve Cork¹, Nicky Grigg³, Tim Kasser⁴, and Ida Kubiszewski¹

1. Crawford School of Public Policy, the Australian National University, Canberra
2. Australian Catholic University, Sydney
3. CSIRO Land and Water, Canberra
4. Knox College, Galesburg, Illinois, USA

THIRD EDITION

MOTIVATIONAL INTERVIEWING

Helping People Change

William R. Miller
Stephen Rollnick

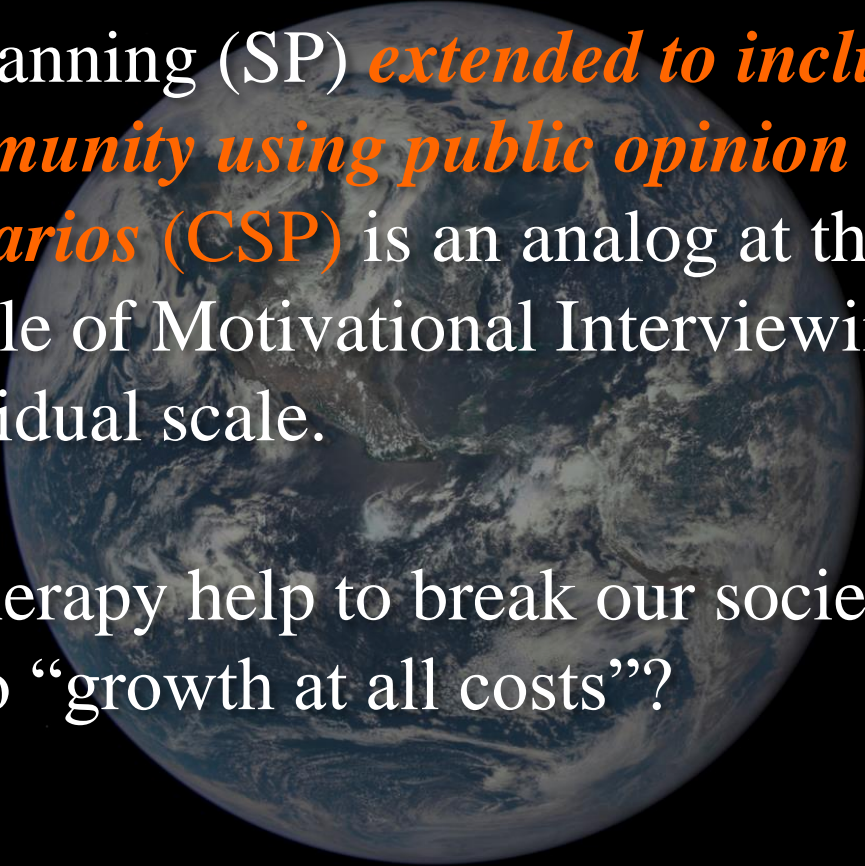
Motivational Interviewing (MI) is one of the most effective therapies for treatment of substance addictions

Based on engaging addicts in *a positive discussion* of their goals, motives, and futures.

MI suggests that there are four basic principles that underlie successful therapies.

In a societal context, these basic MI principles can be summarized as:

1. **Engaging:** *building relationships with diverse stakeholders to enable change talk*
2. **Focusing:** *developing shared goals among those stakeholders*
3. **Evoking:** *helping stakeholders identify motivations for positive change*
4. **Planning:** *helping stakeholders move from goals to actual change*



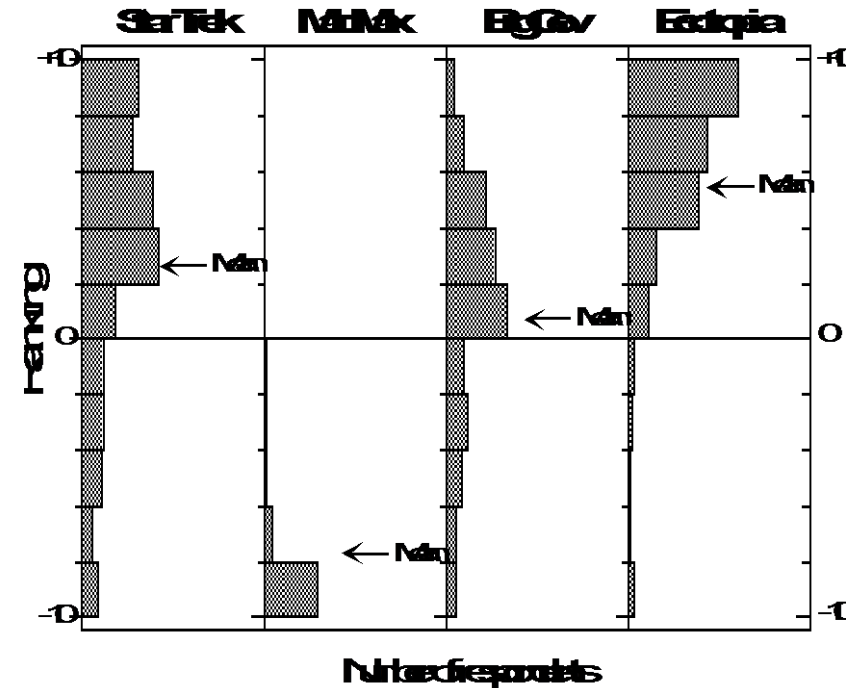
Scenario planning (SP) *extended to include the entire community using public opinion surveys of the scenarios* (CSP) is an analog at the societal scale of Motivational Interviewing (MI) at the individual scale.

Can **CSP** therapy help to break our societal addiction to “growth at all costs”?

	Overall Quality of Life of the Scenario			
Scenario exercise	Most desirable (highest quality of life)	Intermediate (based on cooperation)	Intermediate (based on individuals and markets)	Least Desirable (lowest quality of life)
South Africa (Mont Fleur) 1992	Flight of the Flamingos	Icarus	Lame Duck	Ostrich
Costanza, 2000	Ecotopia	Big Government	Star Trek	Mad Max
Special Report on Emissions Scenarios (SRES)	“B2 World” (local stewardship)	“B1 World” (global sustainability)	“A1 World” (world markets)	“A2 World” (national enterprise)
Millennium Assessment	Adapting Mosaic	Global Orchestration	TechnoGarden	Order from Strength
Great Transition Initiative	Great Transition	Policy Reform	Market Forces	Fortress World
New Zealand	Independent Aotearoa	Living on No. 8 Wire	New Frontiers	Fruits for a Few
Future of Iowa Agriculture	4 Steady State	1. Business as Usual	3. Technology will save us	2. Overreach
Great Barrier Reef	Best of Both Worlds	Treading Water	Free Riding	Trashing the Commons

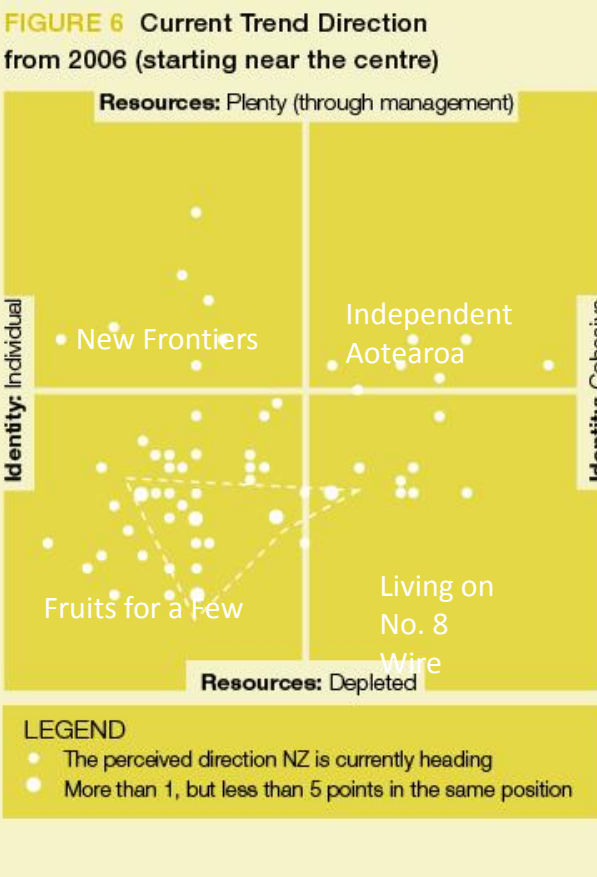
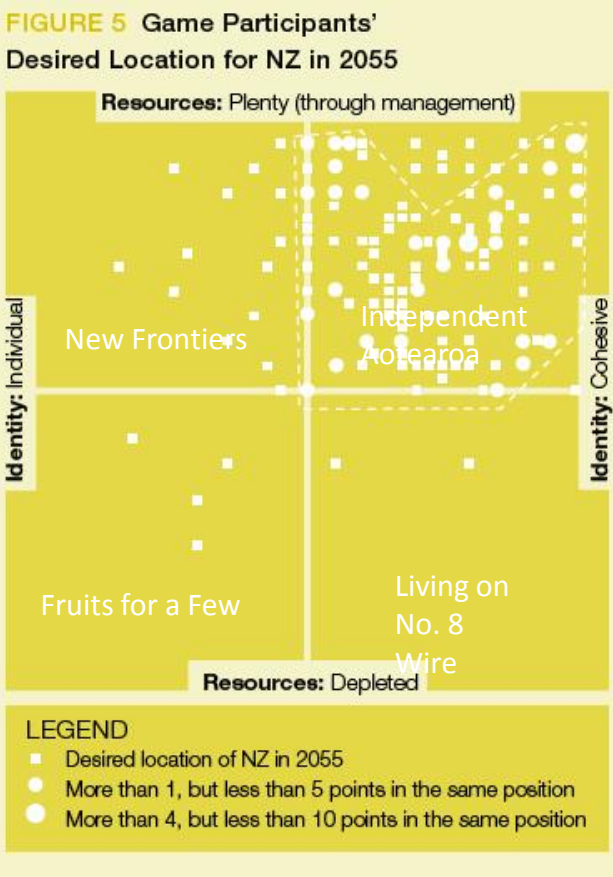
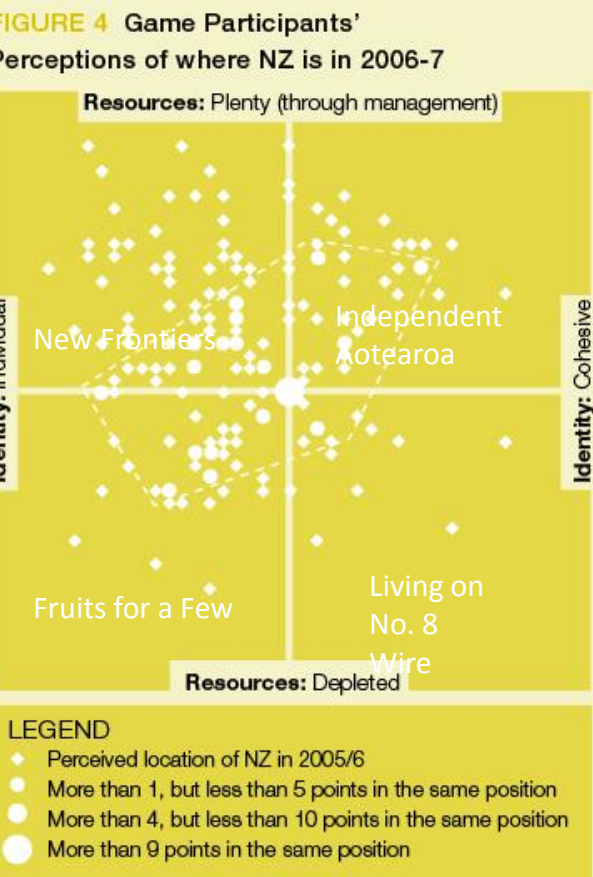
Four Visions of the Future

World View & Policy	Real State of the World	
	Optimists Are Right (Resources are unlimited)	Skeptics Are Right (Resources are limited)
	Technological Optimism	Technological Skepticism
Resources are unlimited Technical Progress can deal with any challenge Competition promotes progress; markets are the guiding principle	Star Trek Fusion energy becomes practical, solving many economic and environmental problems. Humans journey to the inner solar system, where population continues to expand (mean rank 2.3)	Mad Max Oil production declines and no affordable alternative emerges. Financial markets collapse and governments weaken, too broke to maintain order and control over desperate, impoverished populations. The world is run by transnational corporations. (mean rank -7.7)
Resources are limited Progress depends less on technology and more on social and community development Cooperation promotes progress; markets are the servants of larger goals	Big Government Governments sanction companies that fail to pursue the public interest. Fusion energy is slow to develop due to strict safety standards. Family-planning programs stabilize population growth. Incomes become more equal. (mean rank 0.8)	EcoTopia Tax reforms favor ecologically beneficent industries and punish polluters and resource depleters. Habitation patterns reduce need for transportation and energy. A shift away from consumerism increases quality of life and reduces waste. (mean rank 5.1)



from: Costanza, R. 2000. Visions of alternative (unpredictable) futures and their use in policy analysis. *Conservation Ecology* 4(1):5. [online]
 URL: <http://www.consecol.org/vol4/iss1/art5>

Work in progress: four future scenarios for New Zealand. Developed by the Landcare Research Scenarios Working Group; documented with additional commentary by Rhys Taylor, Bob Frame, Kate Delaney and Melissa Brignall-Theyer. 2nd ed. – Lincoln, N.Z.: Published by Manaaki Whenua Press, 2007.

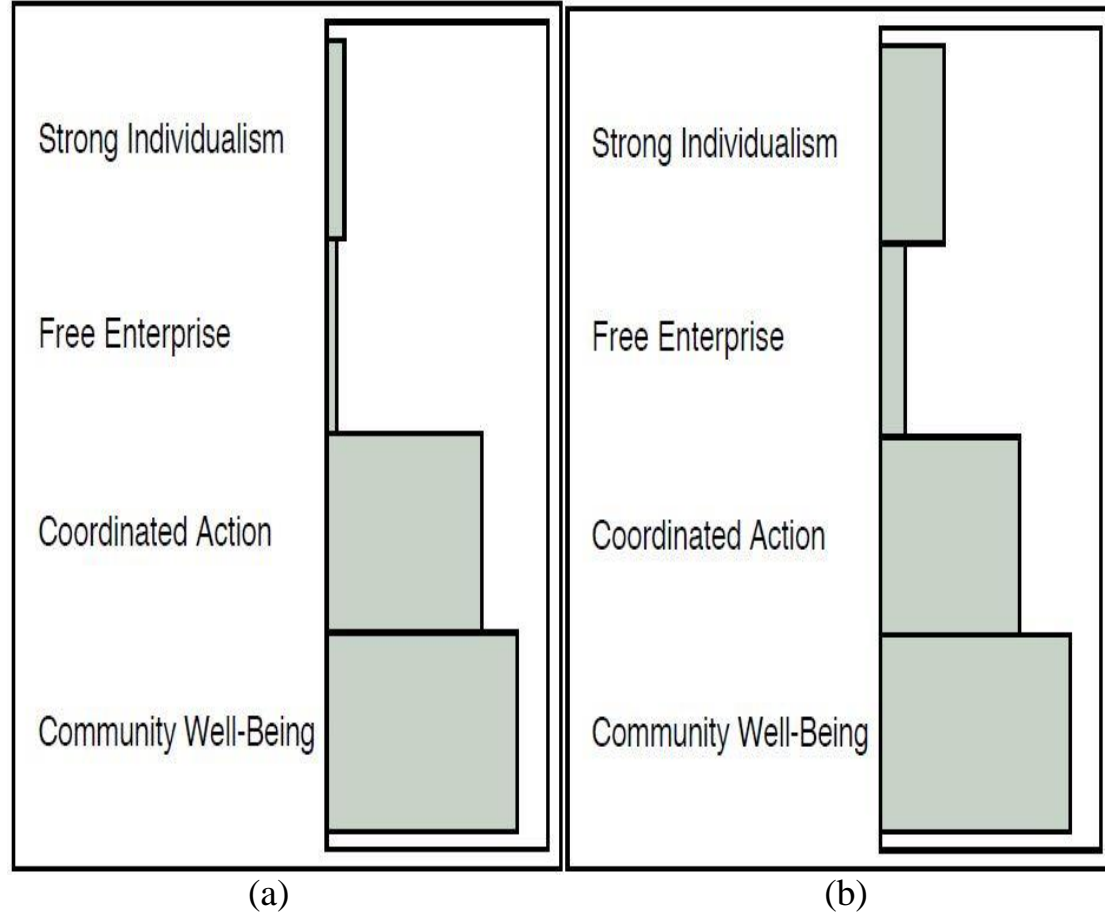


Scenarios for Australia in 2050: A synthesis and proposed survey

Robert Costanza, Ida Kubiszewski, Steve Cork, Paul Atkins, Alexandra Bean, Alexis Diamond, Nicola Grigg, Emily Korb, Jasmin Logg-Scarvell, Rajkumari Navis, and Kimberley Patrick, 2015. *Journal of Future Studies* 19:49-76



<http://www.anuscenarioplanning.com/>



Comparison between (a) the individual choices for scenarios and (b) perceptions on most Australians preferences on future scenarios. n=67

Semester 1, 2016, Tuesdays 4-7 PM

Course Conveners: Prof Robert Costanza and Dr. Ida Kubiszewski

EMDV 8126 Sustainable Solutions Workshop

Surveying Alternative Future Scenarios for Australia



This course will engage students, faculty, and stakeholders in a unique application of scenario planning in Australia. We will use previously developed scenarios to create a public opinion survey of Australians about the futures they prefer. We will design and implement the survey, interpret the results, and publish the findings.

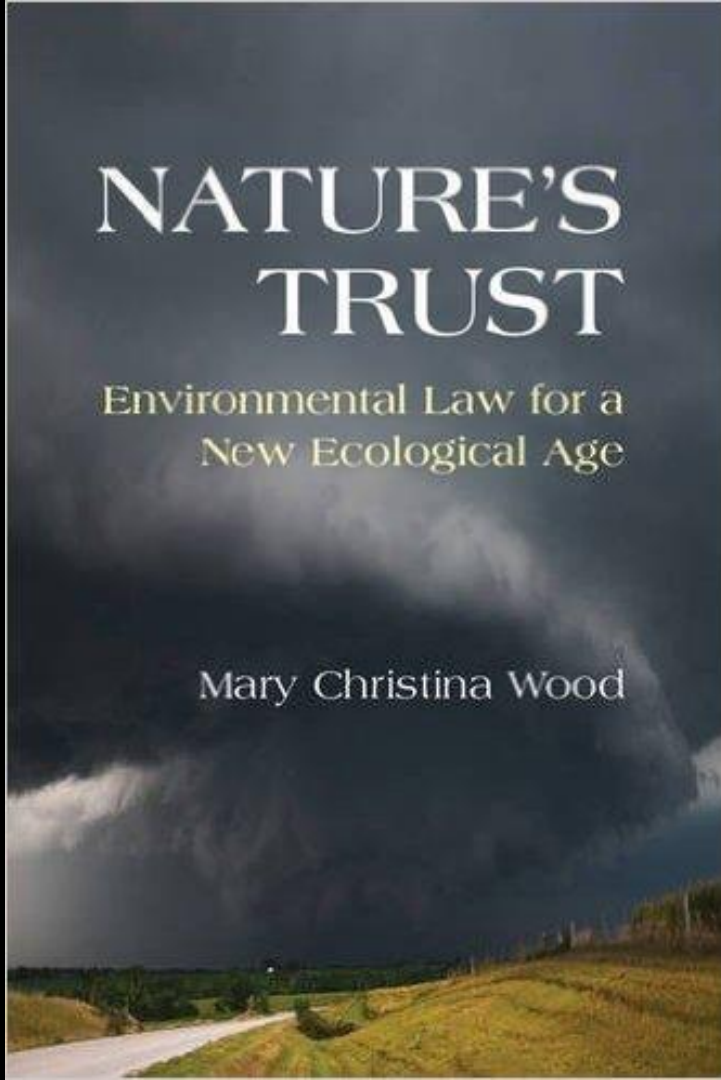
The course will use an interactive, solutions-focused format to:

- Review the literature on scenario planning in Australia and the world
- Review a set of plausible future scenarios that have been developed for Australia
- Describe those futures in a number of ways, that communicate with a broad audience, including narratives, graphics, and video
- Design, implement, and interpret public opinion surveys about the scenarios
- Prepare publishable articles about the results

NATURE'S TRUST

Environmental Law for a
New Ecological Age

Mary Christina Wood



Claim the Sky!

By asserting that we all own the sky, under the **Public Trust Doctrine** we can use the legal institutions surrounding property rights to create an **Earth Atmospheric Trust** to protect our common property, charge for damages, and provide rewards to those that improve this shared asset.



Solutions, Volume 6, Issue 1, 2015.
<http://www.thesolutionsjournal.com/>

<http://www.theguardian.com/sustainable-business/2015/dec/22/climate-change-environmental-activists-cop21-vulnerable-countries-washington-netherlands->

INVOICE

Date: [Soon]

To: [Company XX]

Under the Public Trust doctrine, you are hereby assessed for damages to the Global Atmospheric Commons:

\$[X,XXX] per cumulative ton of CO₂ equivalent introduced into the global economy from ~~the~~ to ~~the~~ (based on the latest IPCC estimates of damages), plus ongoing damages:

= \$[X,XXX.00]

Deposit this amount to the Global Atmospheric Trust Fund within 90 days or face legal action and sanctions by the shareholders of the Trust—the people of Earth.

Monies in this fund will be used exclusively to maintain and improve the atmosphere for the benefit of all shareholders, present and future. These uses include, but are not limited to:

1. Investment in community owned, low-carbon emitting renewable energy sources, such as wind and solar.
2. Investment in carbon sequestration projects including forests, soils, and wetlands.
3. Investment in urban infrastructure improvements to reduce car use and improve building energy performance.
4. Investment in technology development to enhance and accelerate the above.

As an alternative to paying this invoice in full, you may invest an equivalent amount in projects that have been approved and monitored by the Trust in one of the categories above.

Signed,



Shareholders in the Earth Atmospheric Trust



Online and Print; Hybrid peer-reviewed academic journal and popular magazine; Uses a more participatory and transdisciplinary review process; Focuses on seriously creative dialog rather than debate

Editor in Chief: Robert Costanza **Associate Editors:** David Orr, Paul Hawken, and John Todd **Managing Editor:** Ida Kubiszewski

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Purpose

ASAP was created by several members of the International Expert Working Group (IEWG), convened by the King of Bhutan with the objective of designing a New Development Paradigm (NDP), to invite wider participation by a cross-section of society and facilitate the global movement to craft a sustainable future by

1. Bringing together parties interested in redefining the relationship between humans, economic life and nature, and
2. Serving as a collective forum for information, debate and exchange.

ASAP content will represent the best of the collective knowledge of its contributors, and will be disseminated in multiple fora and in various formats, for multiple audiences.

All submissions will be accepted provided they fulfill the [General Guidelines](#), and ASAP's steering committee, initially drawn from the IEWG, will evaluate and select submissions that add real value to the best practice information already on hand. Moderated debate will allow a productive exchange of views.

Thank You

