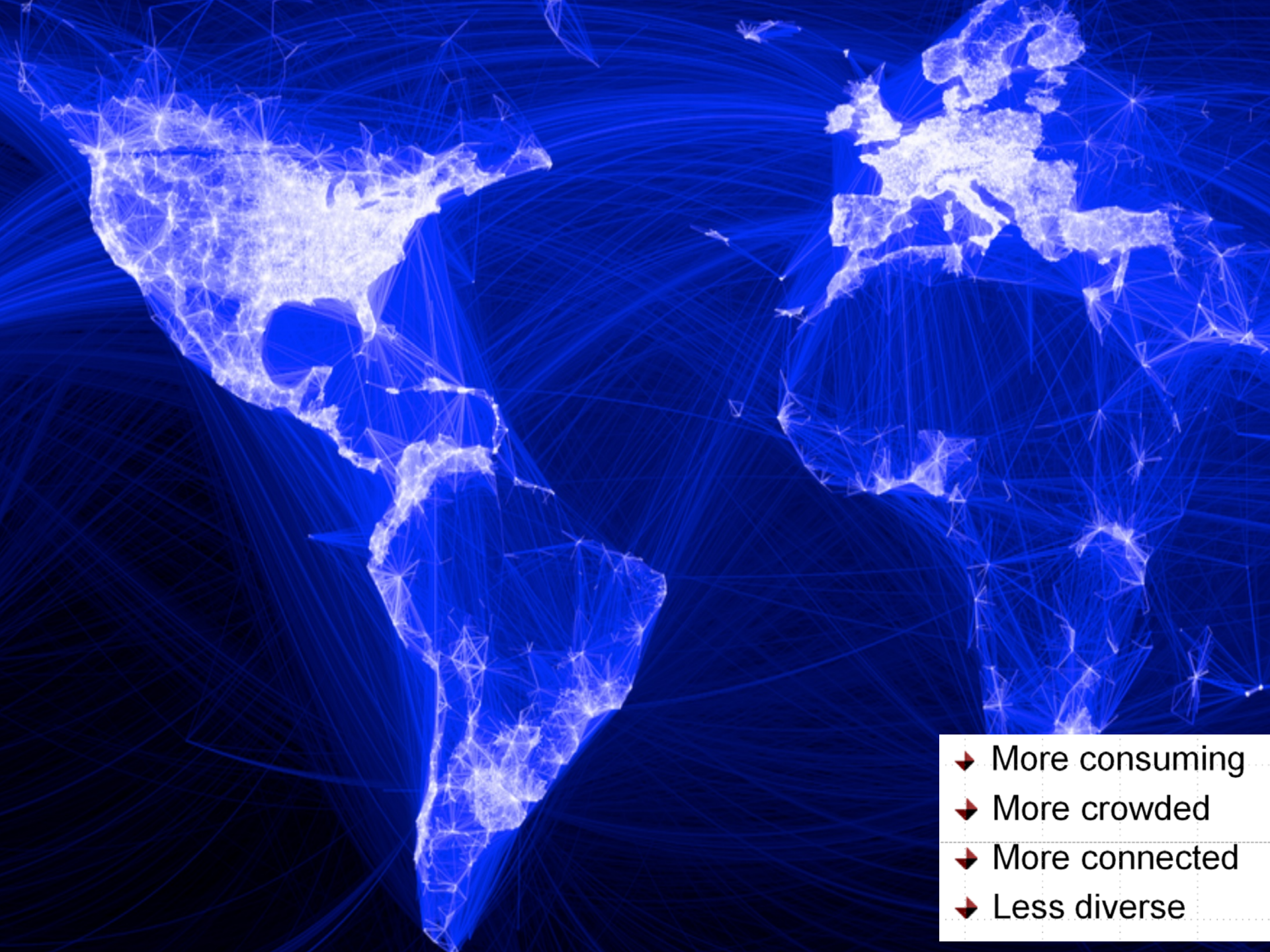
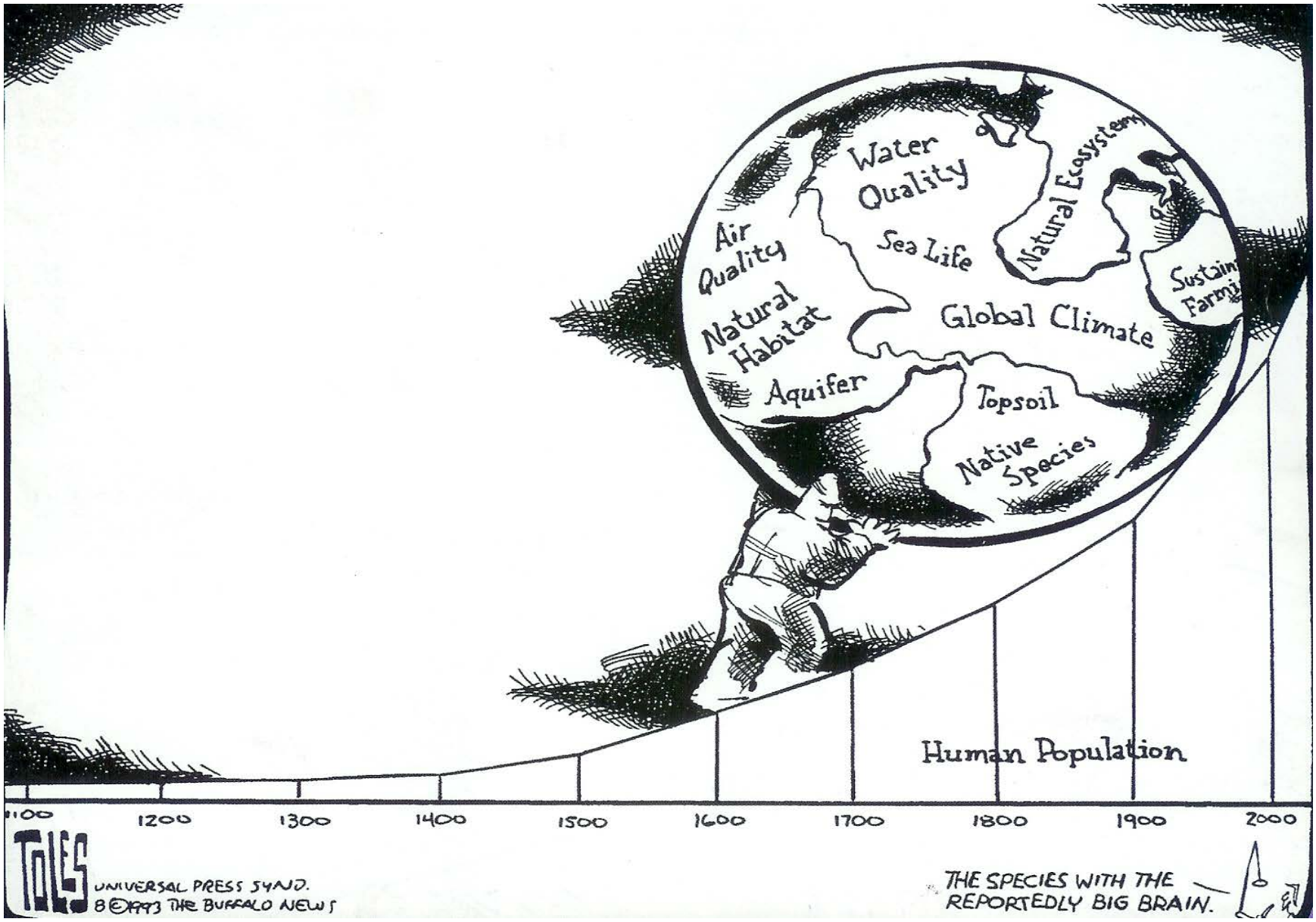
Sustainable Solutions in Developing Countries

Bernard Amadei
Mortenson Center in Engineering for Developing Communities
University of Colorado, Boulder

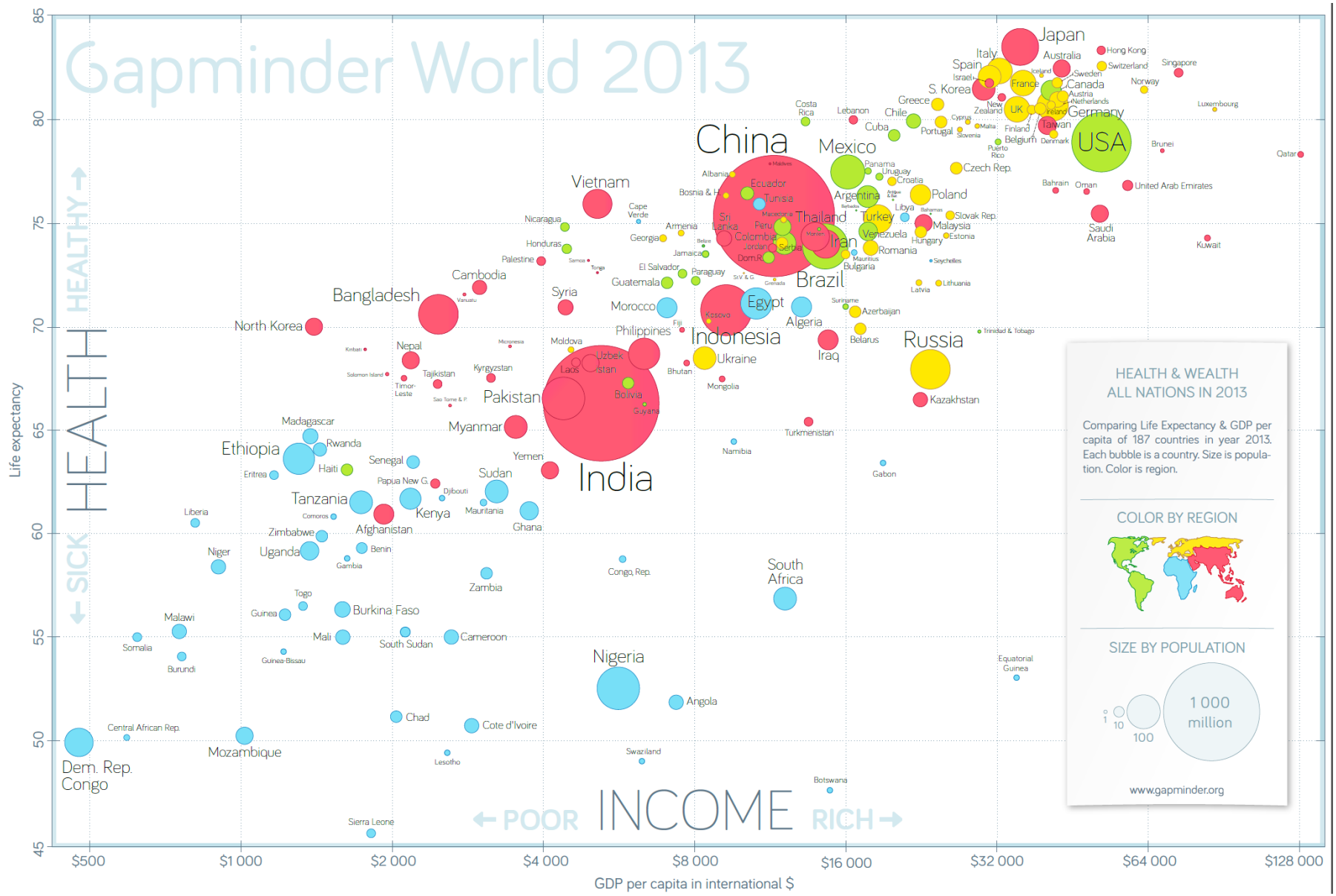
ICTP
March 30, 2016

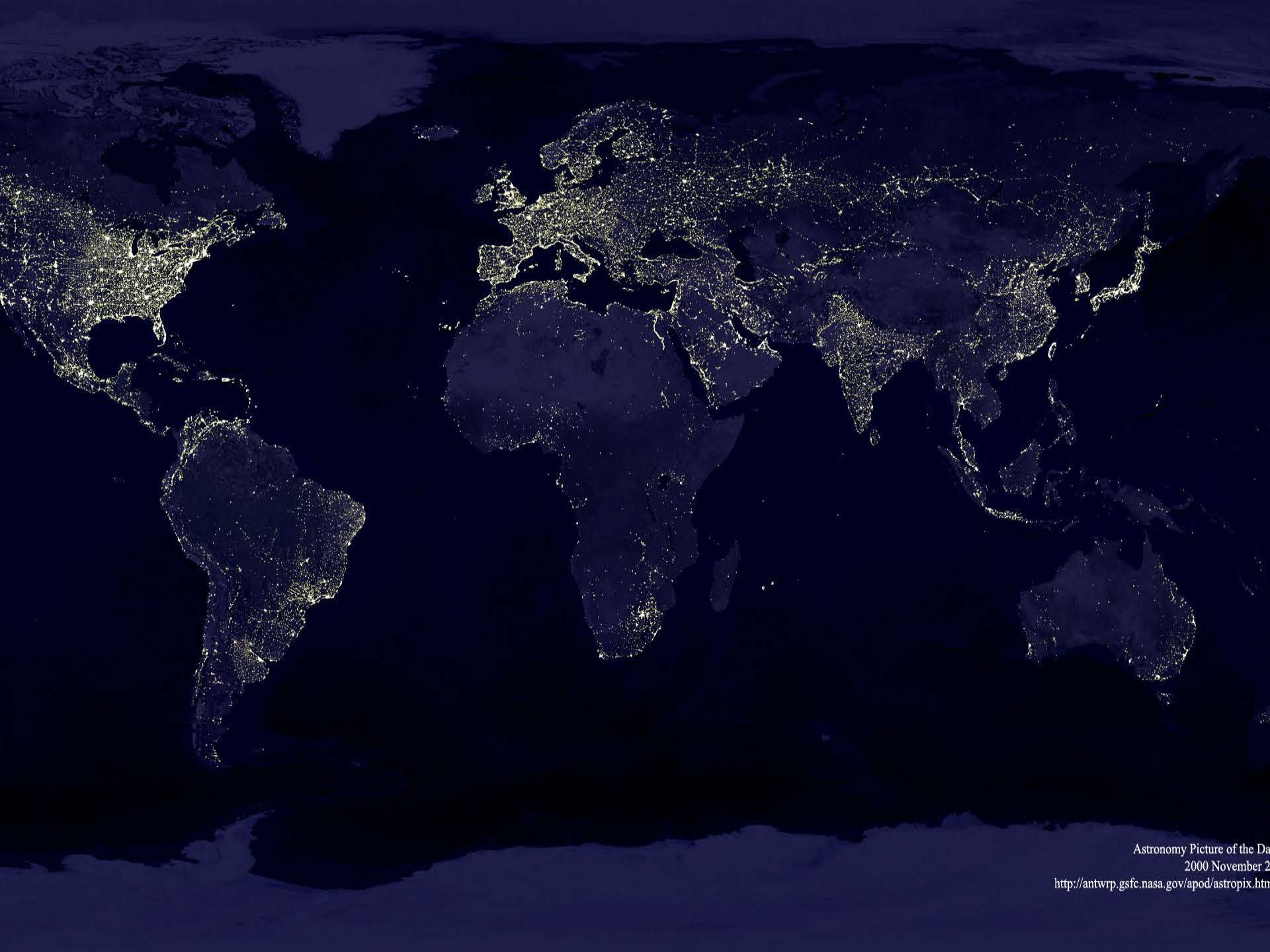

More consuming
More crowded
More connected
Less diverse


Water Quality
Natural Ecosystems
Air Quality
Sea Life
Natural Habitat
Global Climate
Aquifer
Topsoil
Native Species
Human Population
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
TOLES
UNIVERSAL PRESS SYND.
©1993 THE BUFFALO NEWS
THE SPECIES WITH THE REPORTEDLY BIG BRAIN.

Different challenges

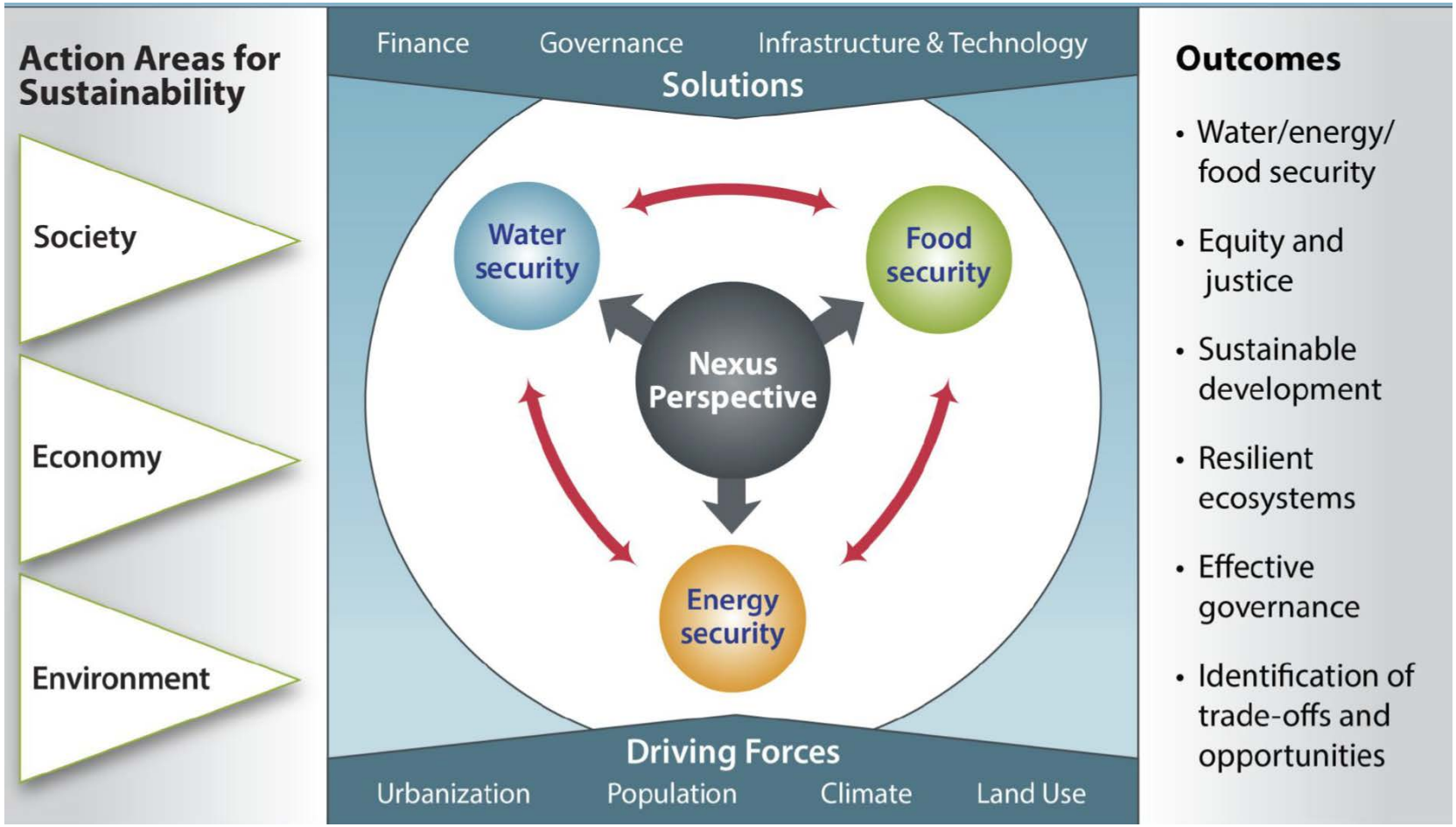
- In the developed world, the challenge is to consume less and more intelligently, and be respectful of natural and human systems
- In emerging markets, the challenge is to grow economically while respecting human and natural systems
- In the developing world, the challenge is to ensure that proposed economic solutions address the basic needs of people and are good to the environment


Gapminder World 2013
HEALTH
SICK
HEALTHY
Life expectancy
INCOME
POOR
RICH
GDP per capita in international $
$500
$1 000
$2 000
$4 000
$8 000
$16 000
$32 000
$64 000
$128 000
85
80
75
70
65
60
55
50
45
China
India
USA
Japan
Brazil
Russia
Indonesia
Nigeria
Pakistan
Bangladesh
Mexico
Germany
Vietnam
Iran
Thailand
Egypt
Ethiopia
Dem. Rep. Congo
South Africa
HEALTH & WEALTH
ALL NATIONS IN 2013
Comparing Life Expectancy & GDP per capita of 187 countries in year 2013. Each bubble is a country. Size is population. Color is region.
COLOR BY REGION
SIZE BY POPULATION
1
10
100
1 000
million
www.gapminder.org


Astronomy Picture of the Da
2000 November 2
http://antwrp.gsfc.nasa.gov/apod/astropix.htm

How can *all* humans have fulfilling lives, meet their basic needs, and live with dignity and at peace?

- How do we educate a global community?
- How do we feed a global community?
- How do we power a global community?
- How do we safely hydrate a global community?
- How do we communicate and connect in a global community?
- How do we integrate Science, Technology, and Engineering (STE) in political, social, and economic decisions?
- How do we create a peaceful global community?



After R. Waskom, N. Grigg, and M. Akhbari, 2014

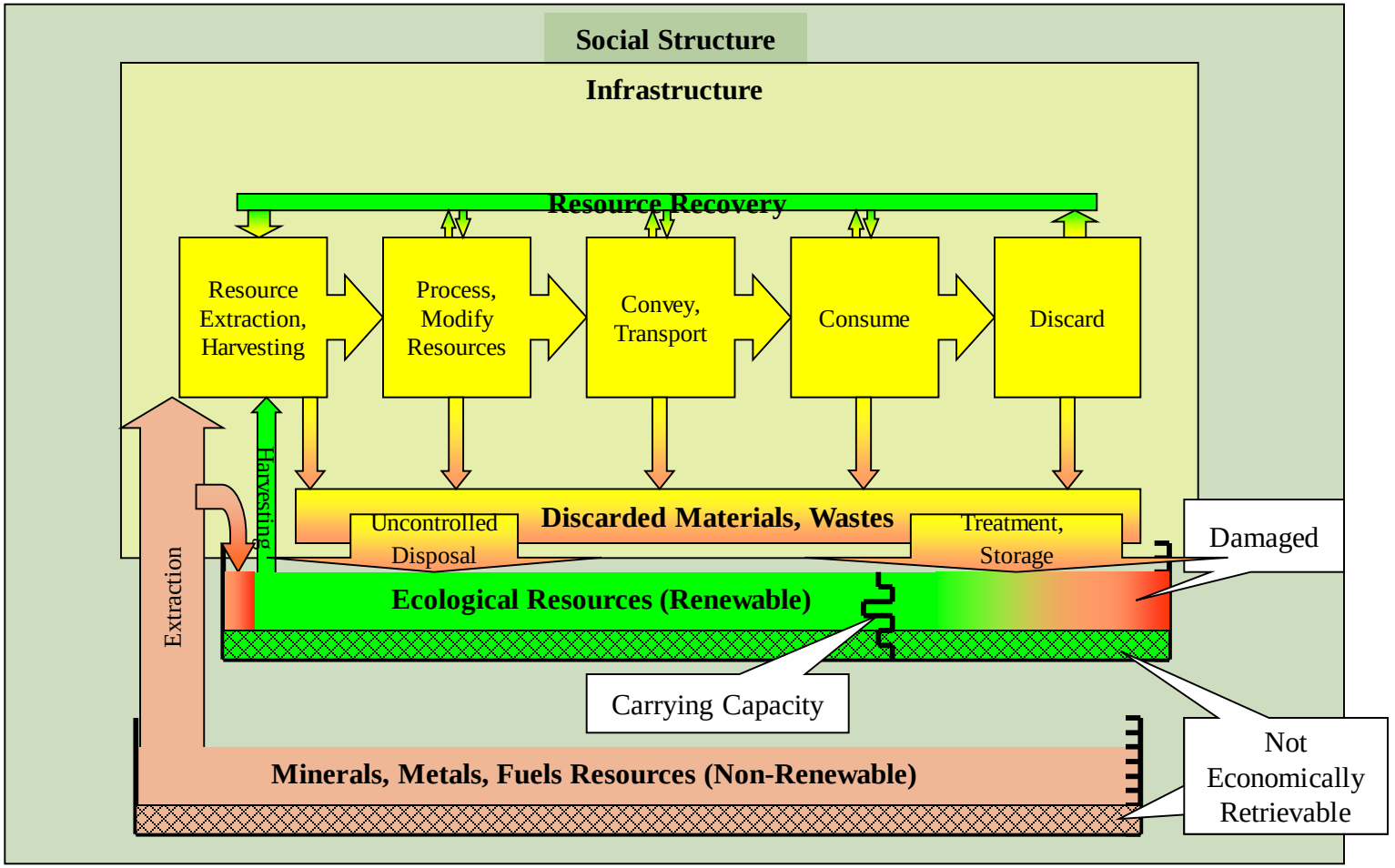
Waste

“Pollution is nothing but the resources we are not harvesting. We allow them to disperse because we've been ignorant of their value.” (Buckminster Fuller)

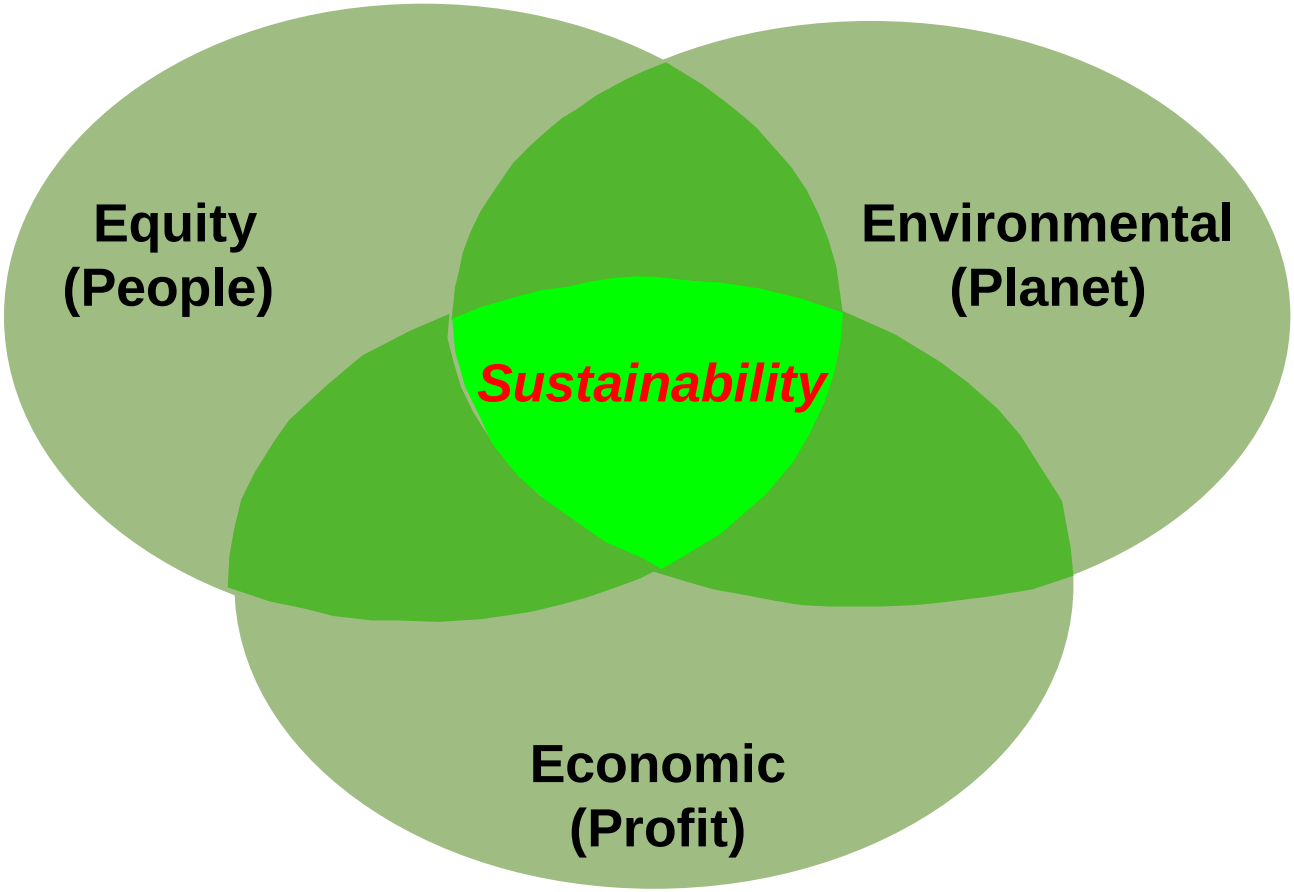
“Our present industrial economy is an immature ecosystem.” (Hawken, 1993)

Production-Consumption Model

Cradle to Grave (Take – Make – Waste)

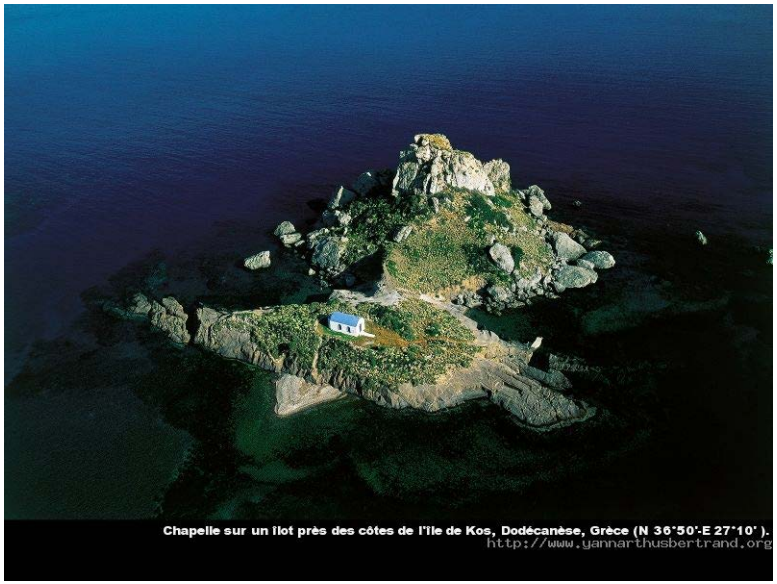


Adapted from D. Roberts and W. Wallace


Equity
(People)
Environmental
(Planet)
Sustainability
Economic
(Profit)

Sustainability

The word “sustainability” comes from “sustain” which comes from a Latin word “sustenere” that means to hold up and prolong, to keep in existence, to endure and withstand.



What do we want/need to sustain?

Preservation of activities that humans can derive their sense of well-being from:

- The natural environment (air, water, land, biota)
- The human race and its basic organizations (family, individuals, communities). Critical issues are body, mind, soul
- The built environment (facilities, infrastructure systems)
- Production systems (goods, products, services)
- Resource base (different types of capital)

With two additional levels of complexity

- Spatial scale of sustainability

  (site, local, state, regional, national, global footprint, etc.)

- Temporal scale of sustainability

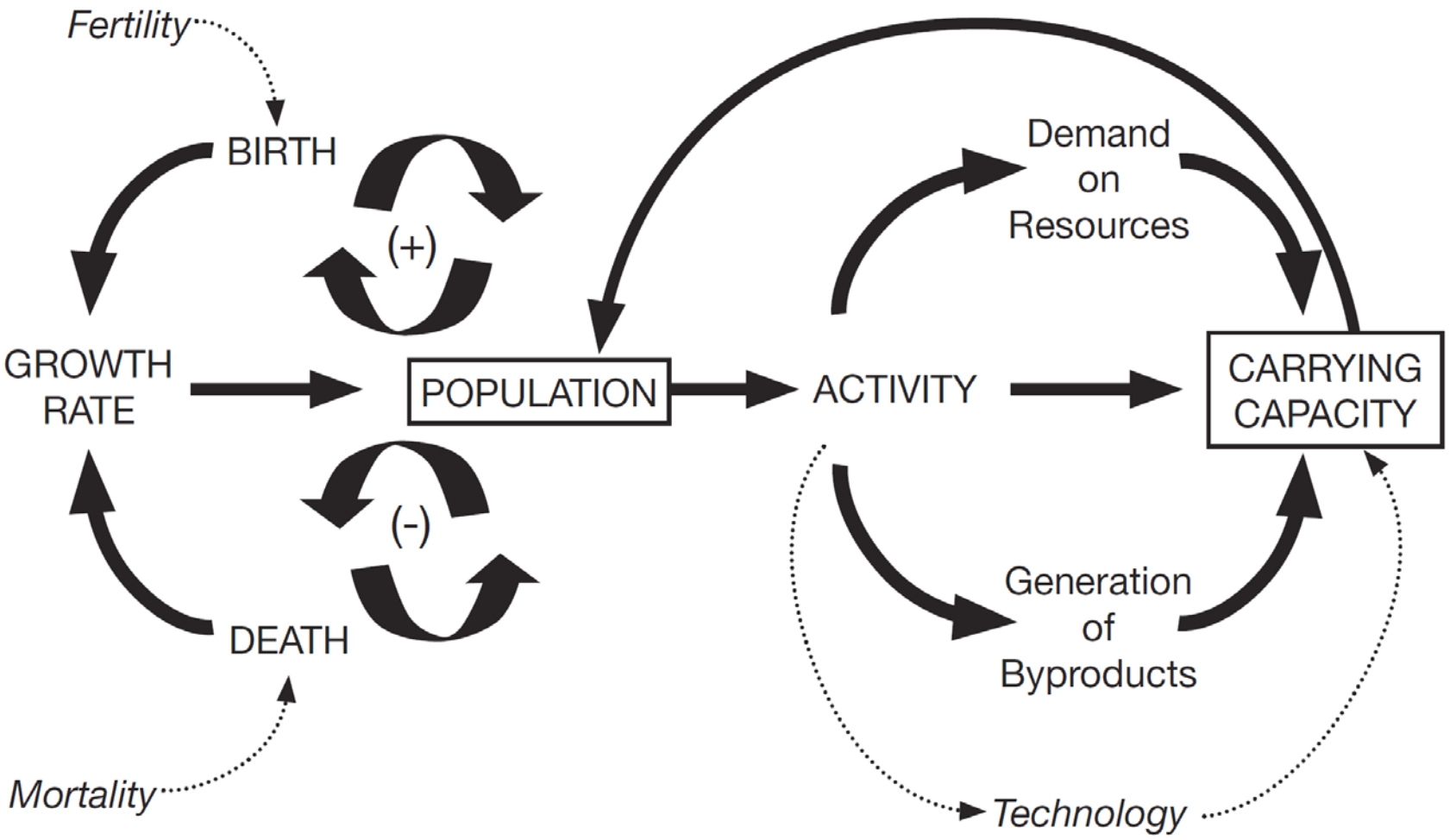
  (today, 1 yr., 1-5 yr., 5-10 yr., etc.)

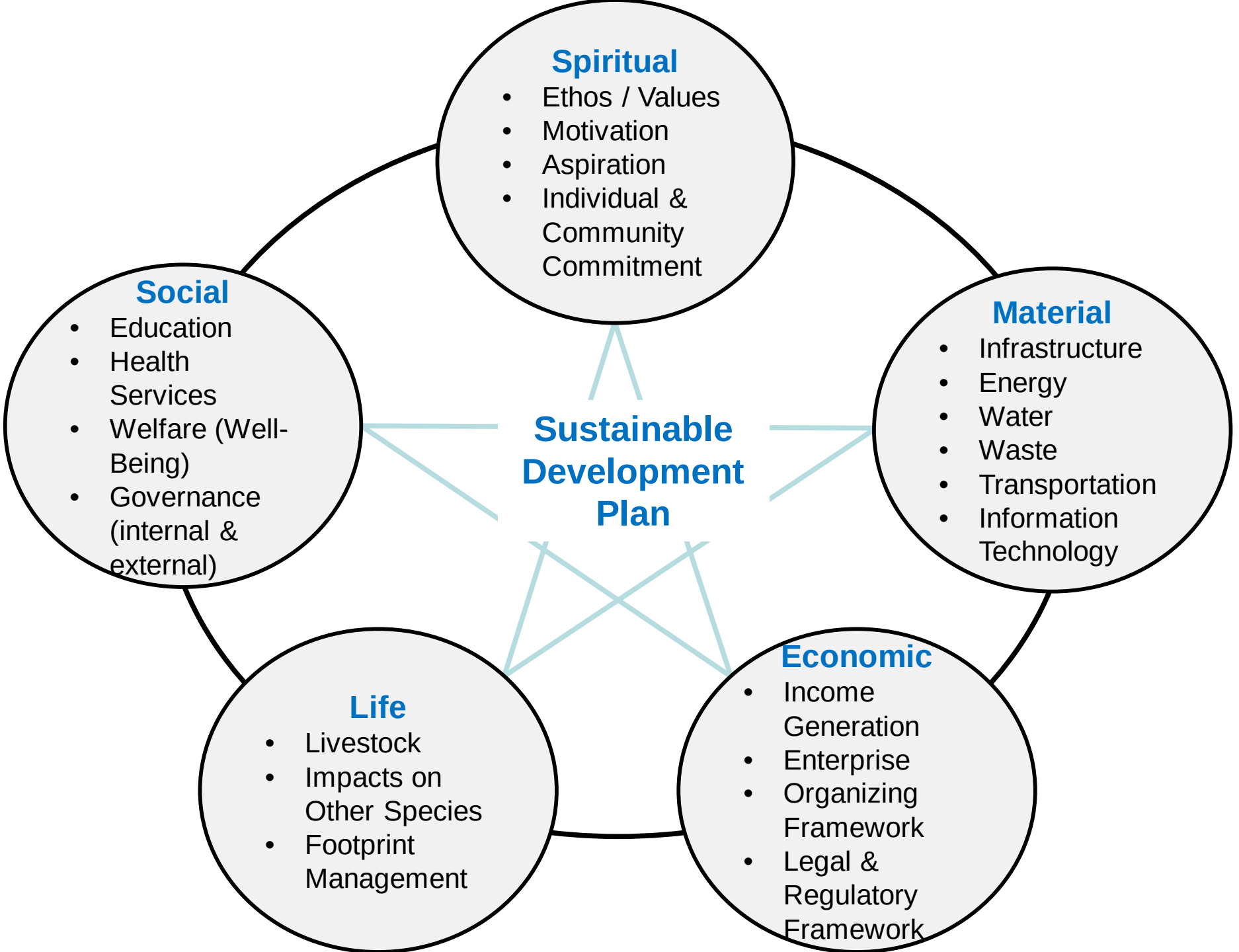
Sustainability

"A dynamic equilibrium in the processes of interaction between a population and the carrying capacity of an environment such that the population develops to express its full potential without adversely and irreversibly affecting the carrying capacity of the environment upon which it depends."

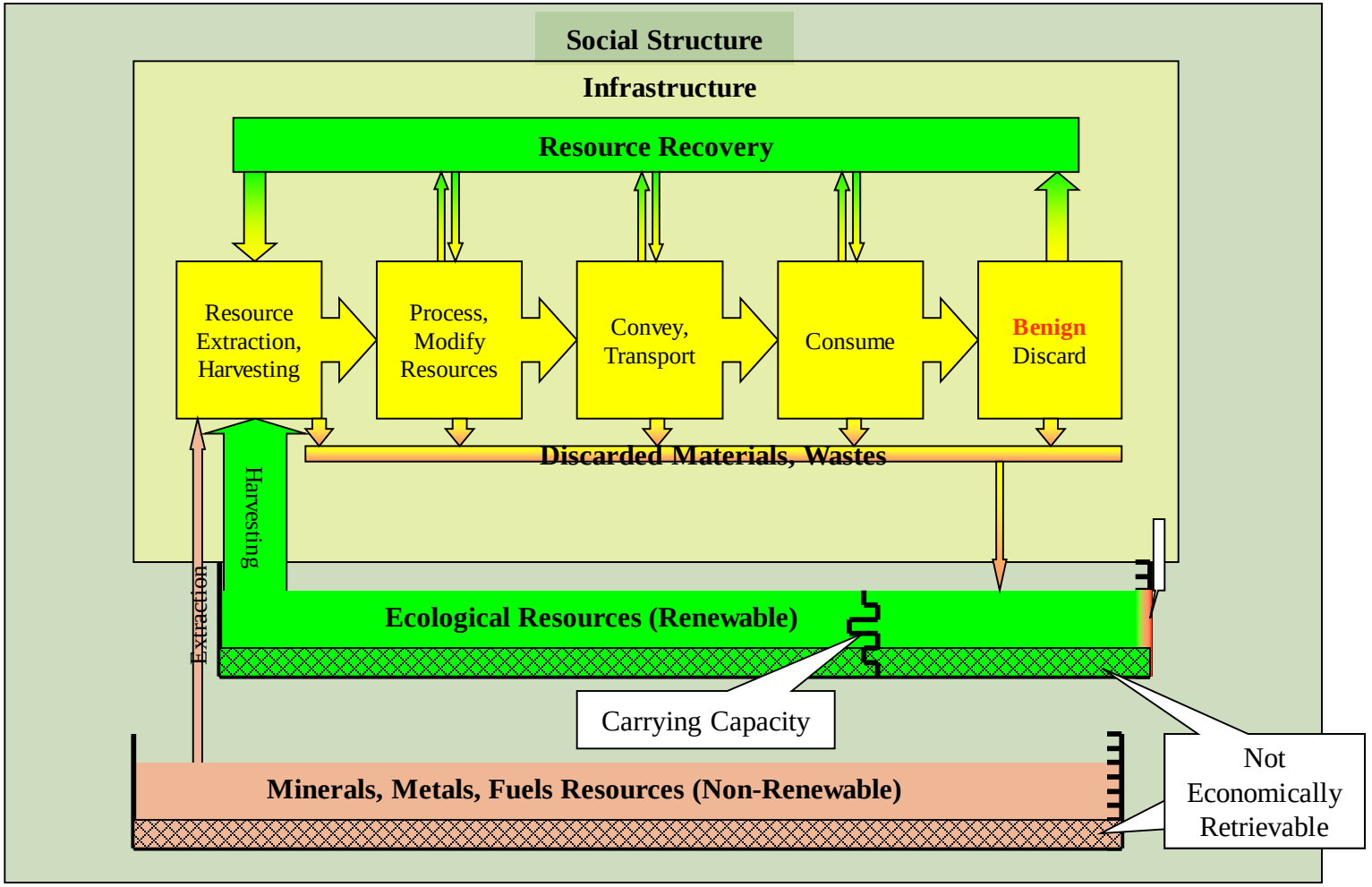
Michael Ben-Eli (2011)

Dynamic Equilibrium




Spiritual
Ethos / Values
Motivation
Aspiration
Individual & Community Commitment
Material
Infrastructure
Energy
Water
Waste
Transportation
Information Technology
Economic
Income Generation
Enterprise
Organizing Framework
Legal & Regulatory Framework
Life
Livestock
Impacts on Other Species
Footprint Management
Social
Education
Health Services
Welfare (Well-Being)
Governance (internal & external)
Sustainable Development Plan

Cradle to Cradle



Take → Make

Waste

"Nature does not have a design problem. People do"

Sustainable Development

“Sustainable development is the challenge of meeting human needs for natural resources, industrial products, food, transportation, shelter, and waste management while conserving and protecting environmental quality and the natural resource base essential for future development.”

(Policy Statement, ASCE TAC Subcommittee on Sustainability, 2001)

Sustainable Development Projects

- Take responsibility for their effects on the natural world by doing no harm and not diminishing the diversity of its systems
- Create structures and systems of durability and long term utility whose ultimate use or disposition will not be harmful to current and future generations
- Change the conversation by educating all stakeholders involved
- Deliver efficient and resource-conserving solutions that reduce consumption, energy use, distribution costs, economic concentration, soil erosion, atmospheric pollution and other forms of environmental damage
- Consider what they take, make and waste
- Deliver solutions that work in harmony with the assimilative and regenerative capacity of the Earth's systems

17 SDG Goals with 100 indicators

“Human Development is about creating an environment in which people can develop their full potential and lead productive, creative lives in accord with their needs and interests. “ (UNDP)

People are the Real Wealth of a Nation

“Sustainable human development is the expansion of the substantives freedoms of people today while making reasonable efforts to avoid seriously compromising those of future generations.” UNDP (2011)

SCD as a process toward creating communities that..

- Allow *all* of their members to enjoy a quality of life where basic human needs and rights and meaningful work are fulfilled in a safe and secure environment.
- Have equitable access to resources and knowledge, thus capable of sustaining themselves economically, socially, and environmentally
- Create opportunities for individuals and households to express their full potential without adversely and irreversibly affecting the carrying capacity of the environment upon which they depend.

SCD as a process toward creating communities that..

- are places where rule of law and good governance are the norm; and
- ensure sustainable livelihood opportunities for future generations.

These five key characteristics contribute to an overall increased level of livelihood, security, and well-being in the basic economic and social units that form the community, i.e. the households

NON-NATURAL SYSTEMS
(Built Environment - Anthrosphere)

vs.

NATURAL SYSTEMS
(Biosphere- Hydrosphere- Geosphere – Atmosphere)

Cartesian
Somewhat predictable
Designed as closed systems
Built to last

Non-Cartesian
Non-linear
Coupled
Chaotic

Diverse
Open
Dissipative
Changing