SUSTAINABILITY:

A Mosaic of Many Small Steps in the Right Direction

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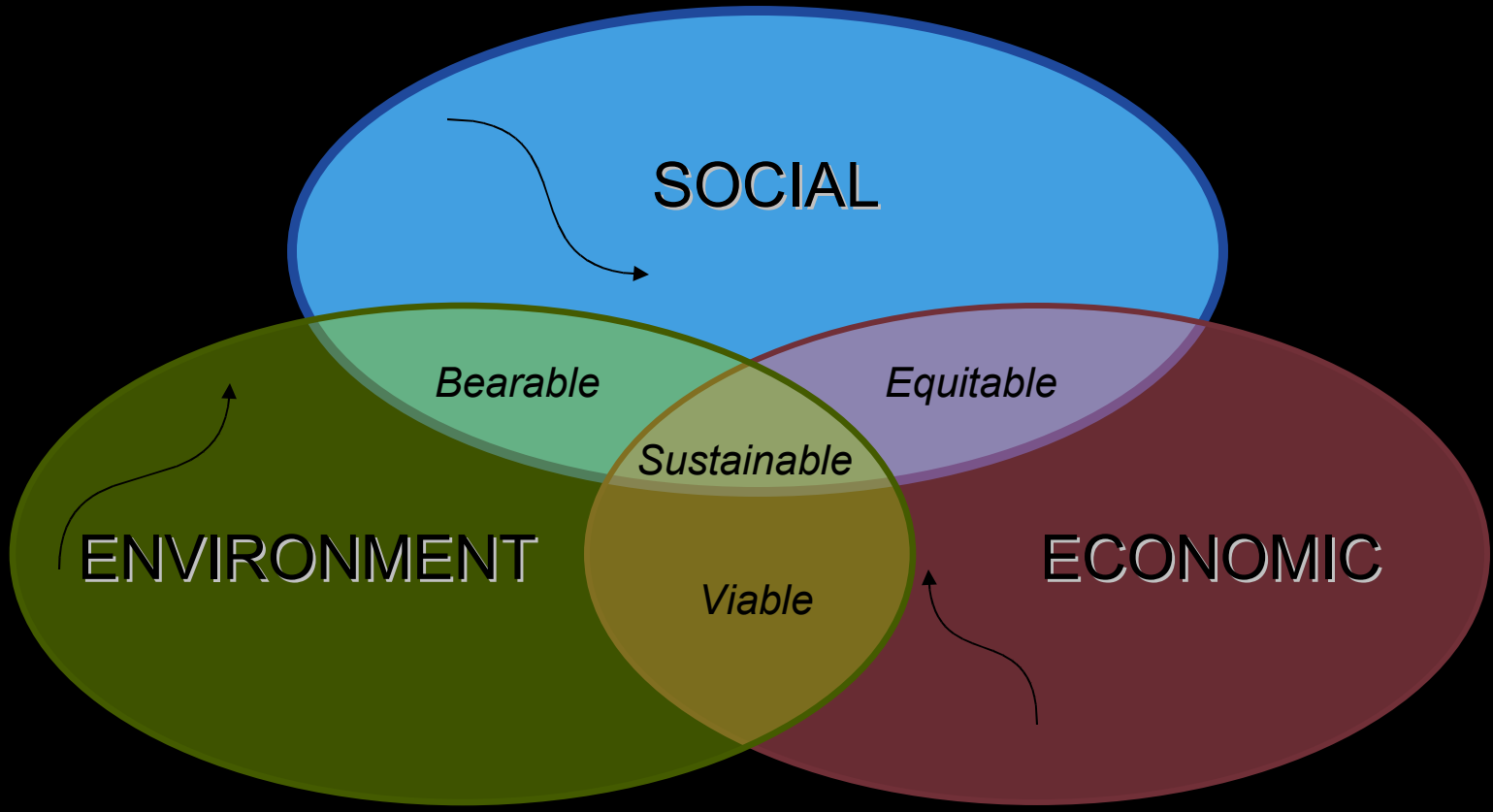
University of Nevada, Reno
Statewide • Worldwide

SUSTAINABILITY:

"Sustainability is a characteristic of a process or state that can be maintained at a certain level indefinitely" - (Wikipedia)



SUSTAINABILITY:

"Sustainability is a characteristic of a process or state that can be maintained at a certain level indefinitely" - (Wikipedia)

Ethical principle or political concept: "Sustainable Development is to meet the needs of the present without compromising the ability of future generations to meet their own needs"

The Brundtland Commission, 1987

Quantitative Definition: Life expectancy of the system, trajectories of certain factors

Operationalization: requires a quantitative definition, a metric to measure, means to predict consequences of action.

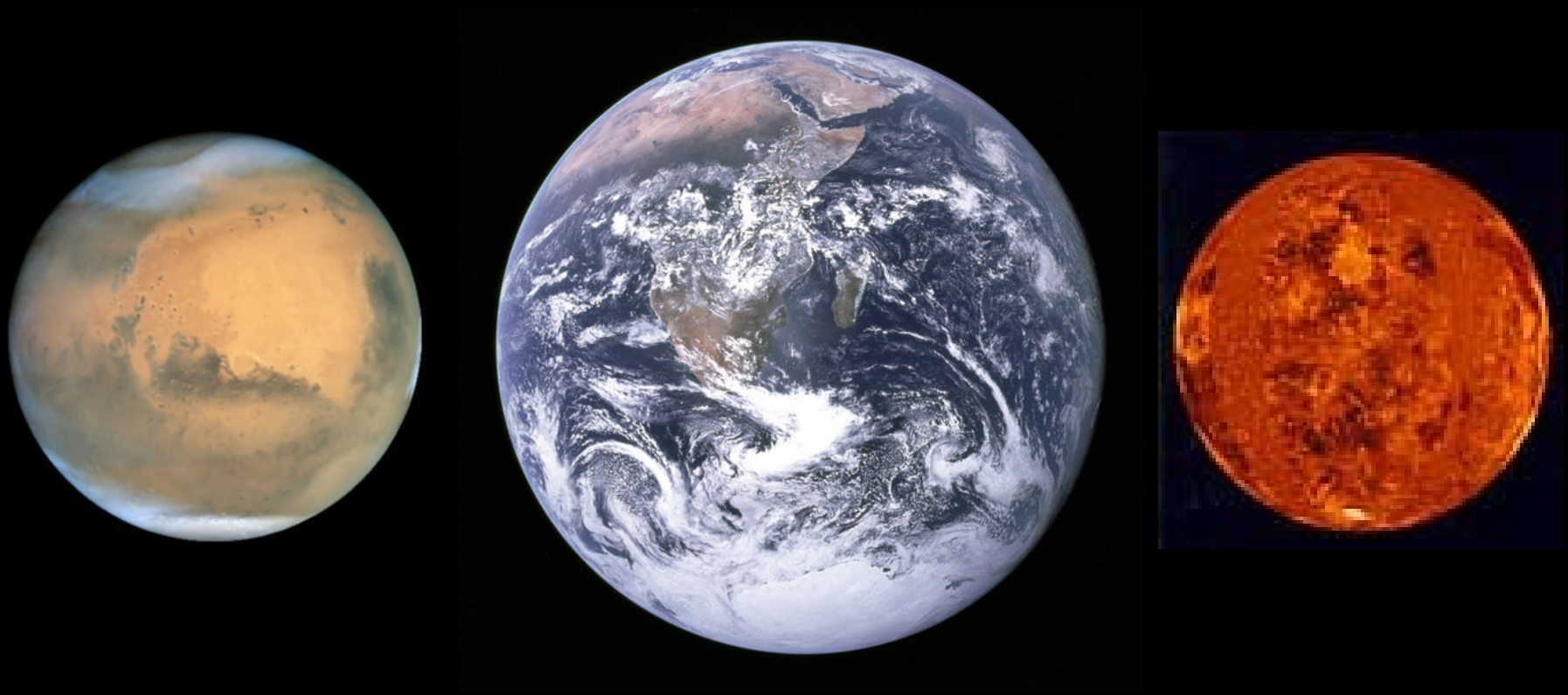
SUSTAINABILITY:

Operationalization: requires a quantitative definition,
a metric to measure,
means to predict consequences of action.

Questions related to Operationalization:

- *How are we in this world?*
- *What role do we play in the Earth system?*
- *What metric do we have to measure sustainability?*
- *How can we decide what steps are going in the right direction?*

Earth is a very special planet… . .



Earth is a living planet …

Earth has an anthrophosphere …

Humanity is amazingly creative …

Humanity is amazingly active and intelligent… . .

$$E = mc^2$$

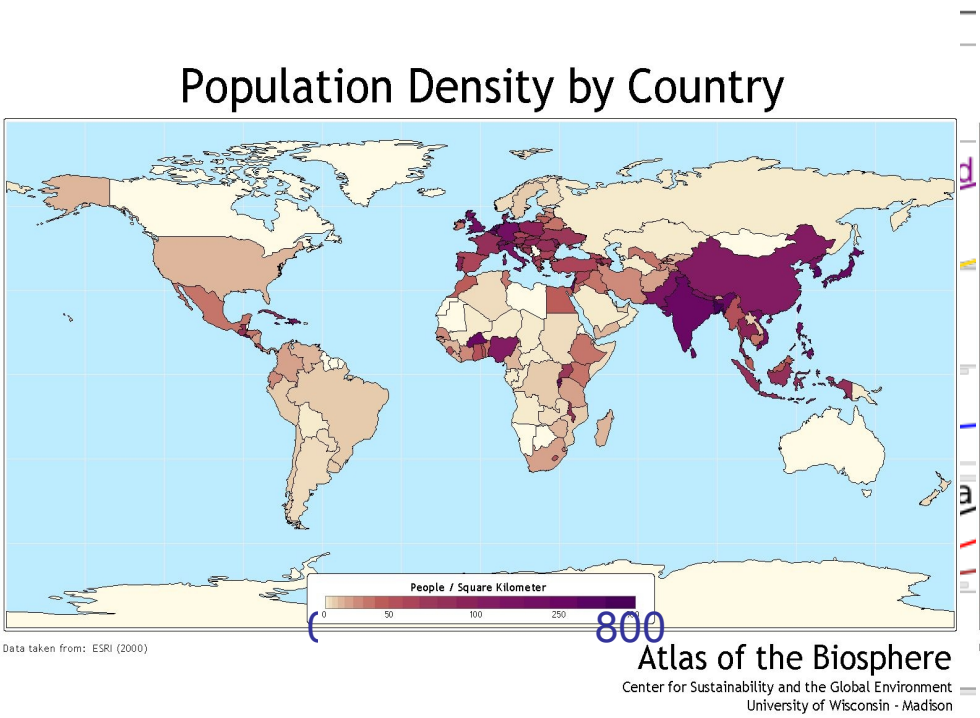
Humanity is dysfunctional and destructive… . .

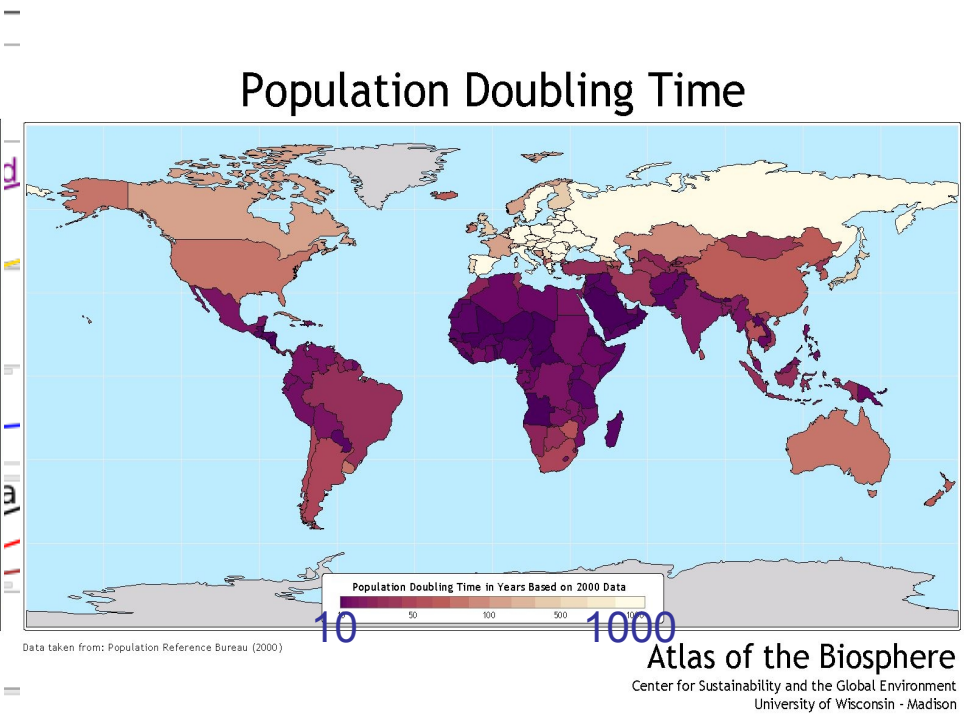
Genocide in the 20th century

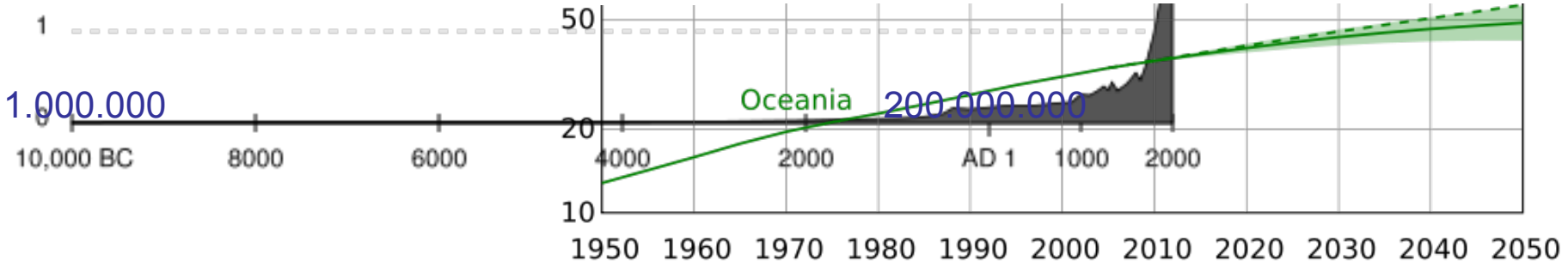
- Bosnia - Herzegovinia: 1992-1995 - 200,000 deaths
- Rwanda: 1994 - 800,000 deaths
- Pol Pot in Cambodia: 1975-1979 - 2,000,000 deaths
- Nazi Holocaust: 1938-1945 - 6,000,000 deaths
- Rape of Nanking: 1937-1938 - 300,000 deaths
- Stalin's Forced Famine: 1932-1933 - 7,000,000 deaths
- Armenians in Turkey: 1915-1918 - 1,500,000 deaths

Humankind has grown

- in number …



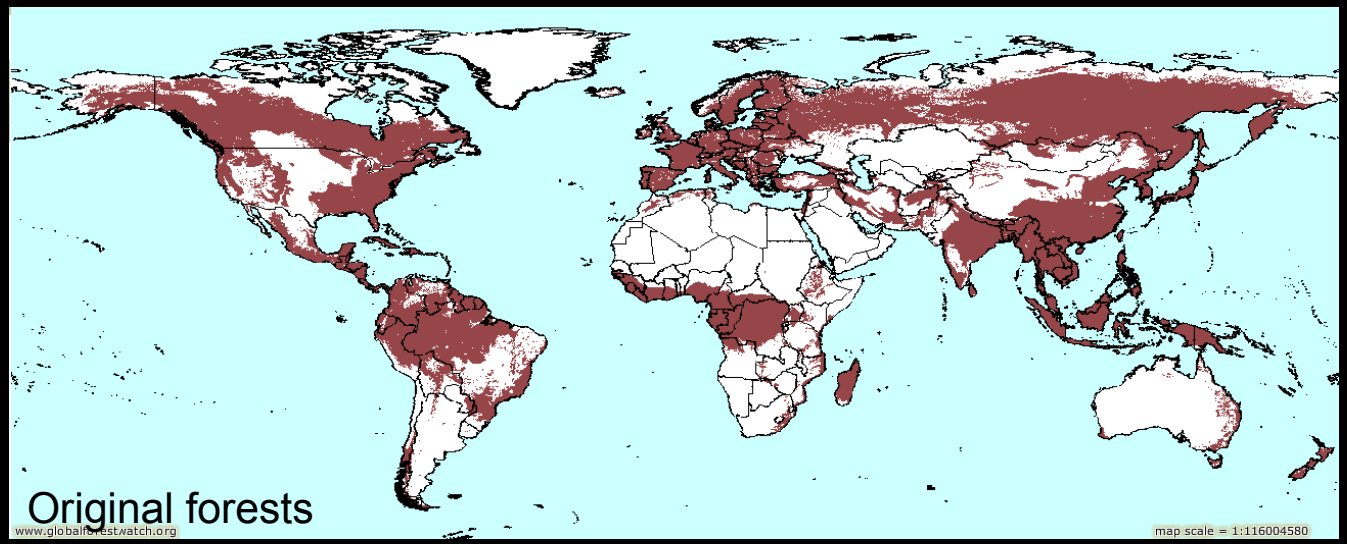


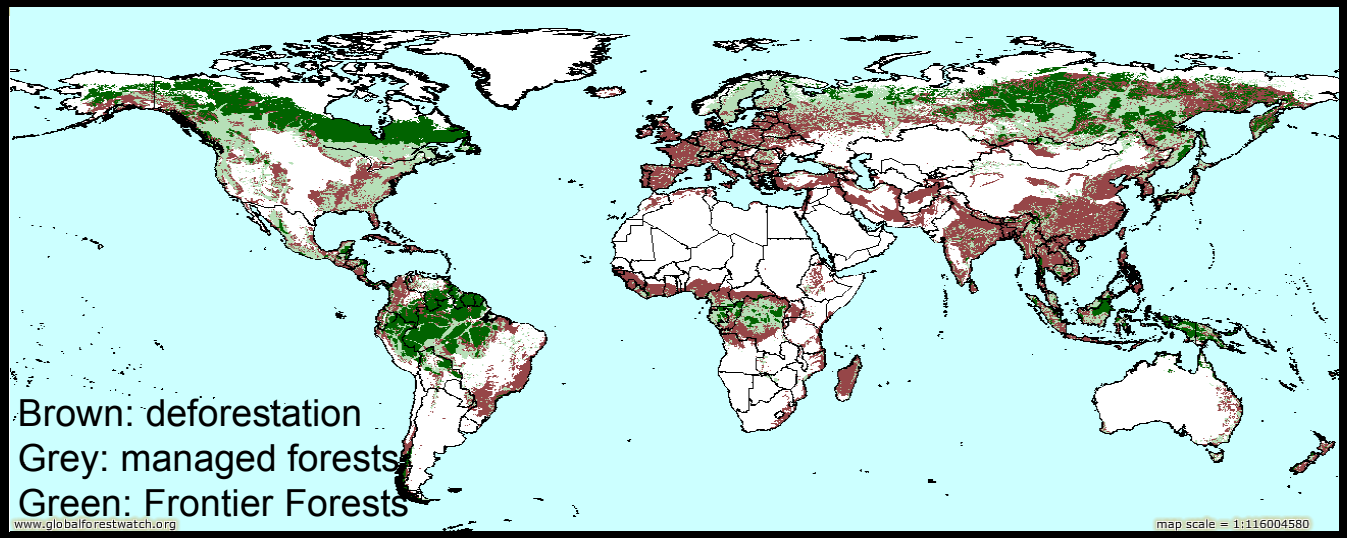


Humankind has grown

- in number …

- in activity: example deforestation…





- About 50% of the original forests are gone;
- Only 20% of frontier forests remain

Humankind has grown

- in number …

- in activity: *example land use…*

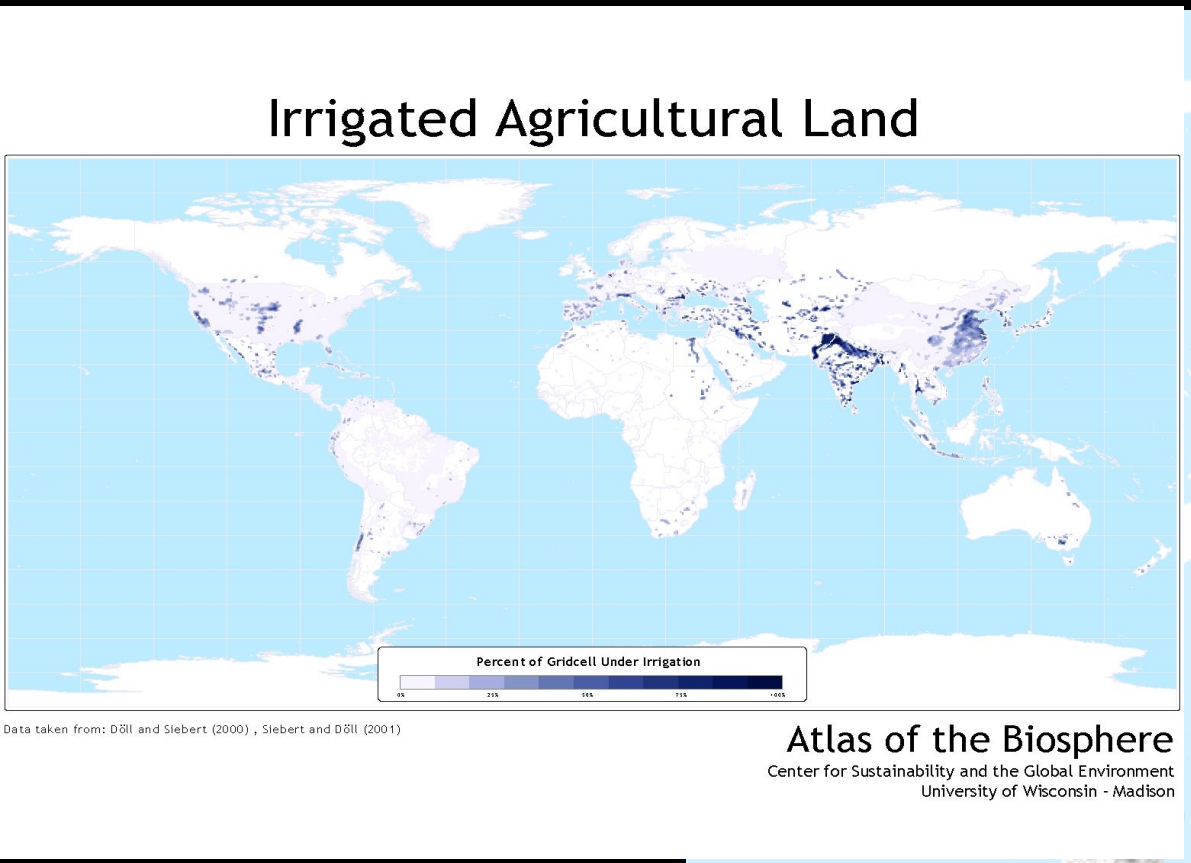
- More than 50% of the ice-free surface of the solid Earth is modified and managed by human activities

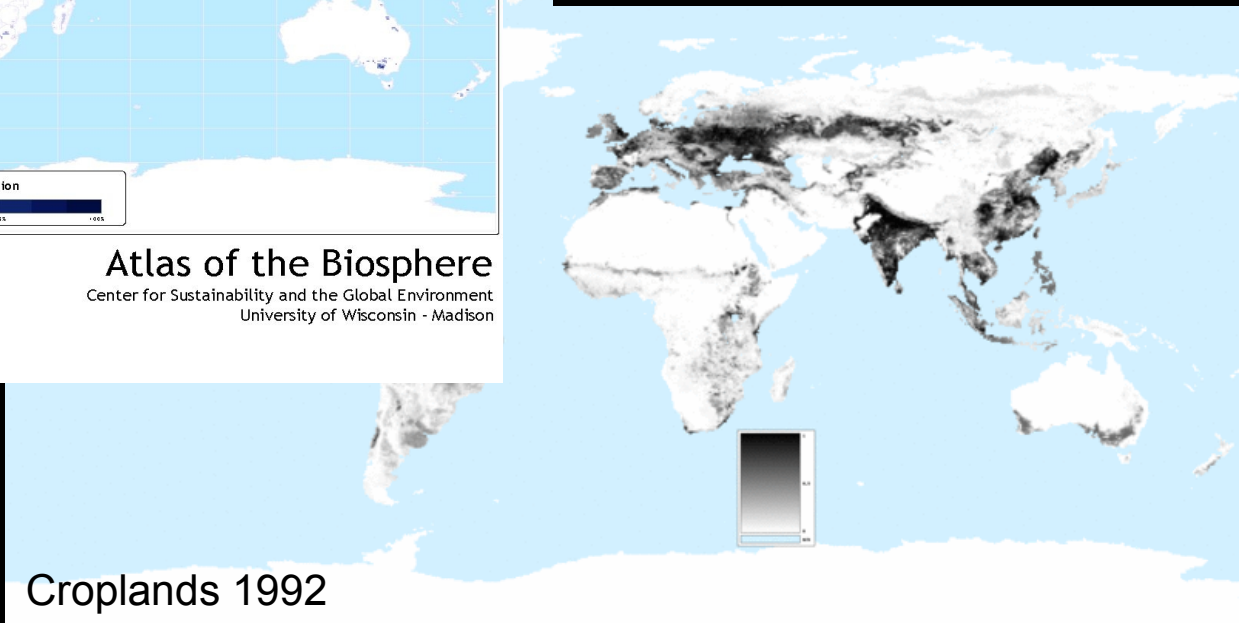
Humankind has grown

- in number …

- in activity: example land use…

- More than 50% of the ice-free surface of the solid Earth is modified and managed by human activities





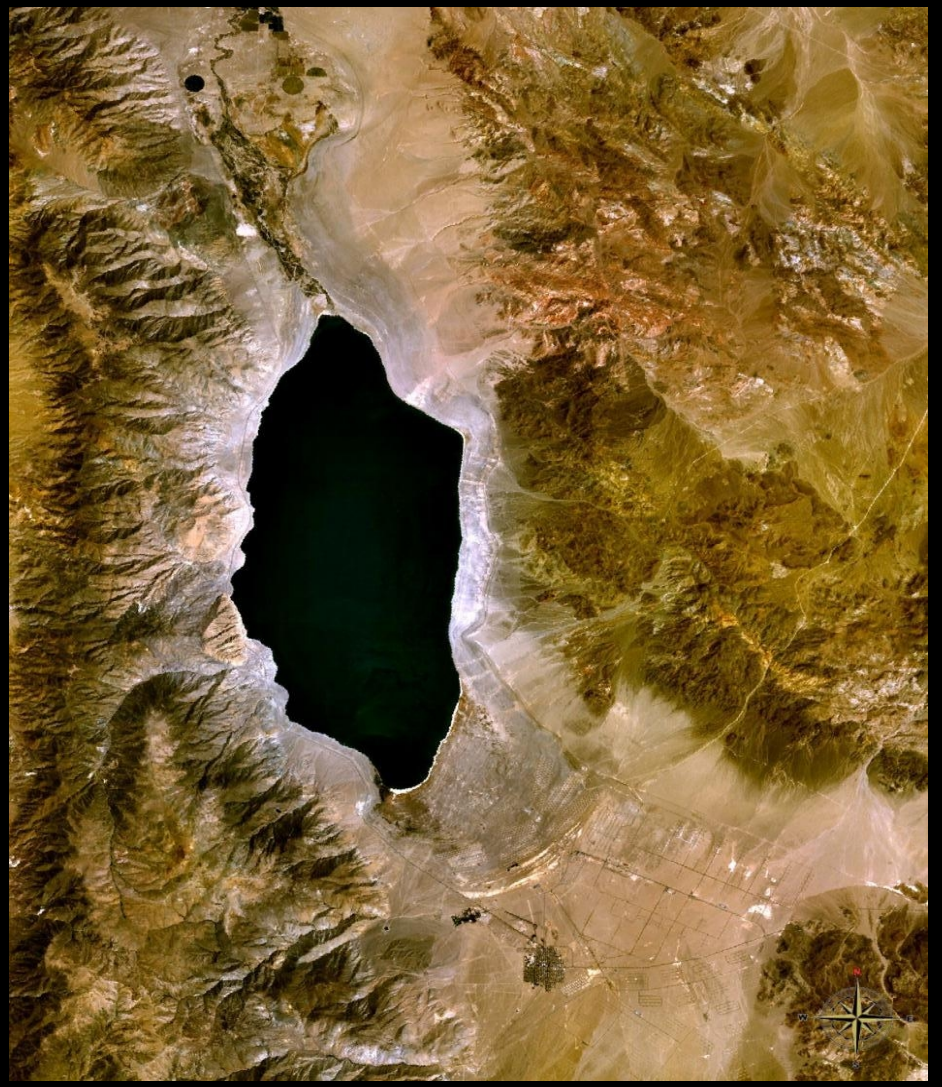
Croplands 1992

Humankind has grown

- *in number …*
- *in activity …*
- *in impact:* *example Aral Sea…*

Humankind has grown

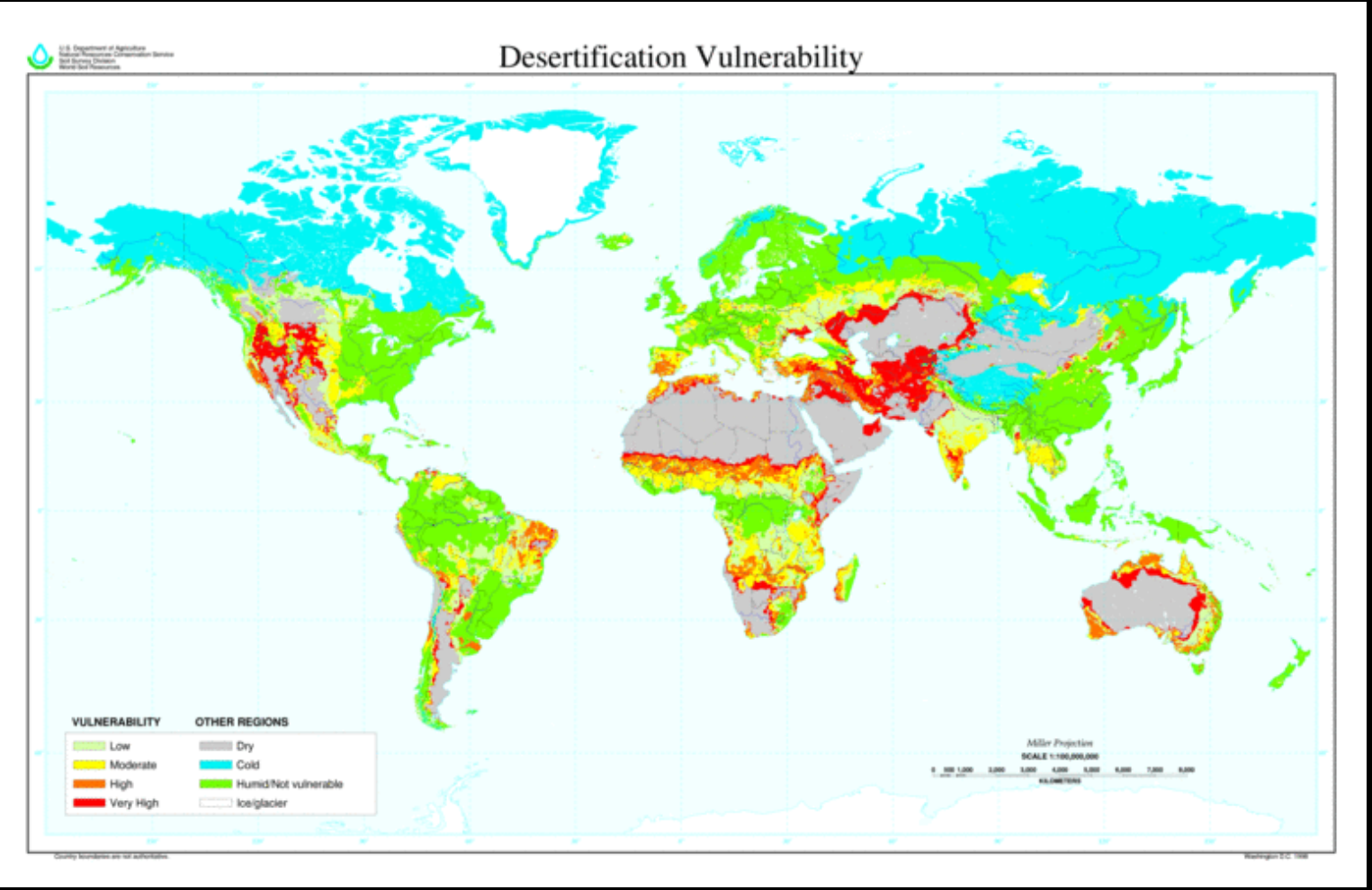
- *in number …*
- *in activity …*
- *in impact:* *example Walker Lake*



- Lake Level dropped by about 50 m since 1880;
- Salinity increased by a factor of five;
- Ecosystem is threatened.

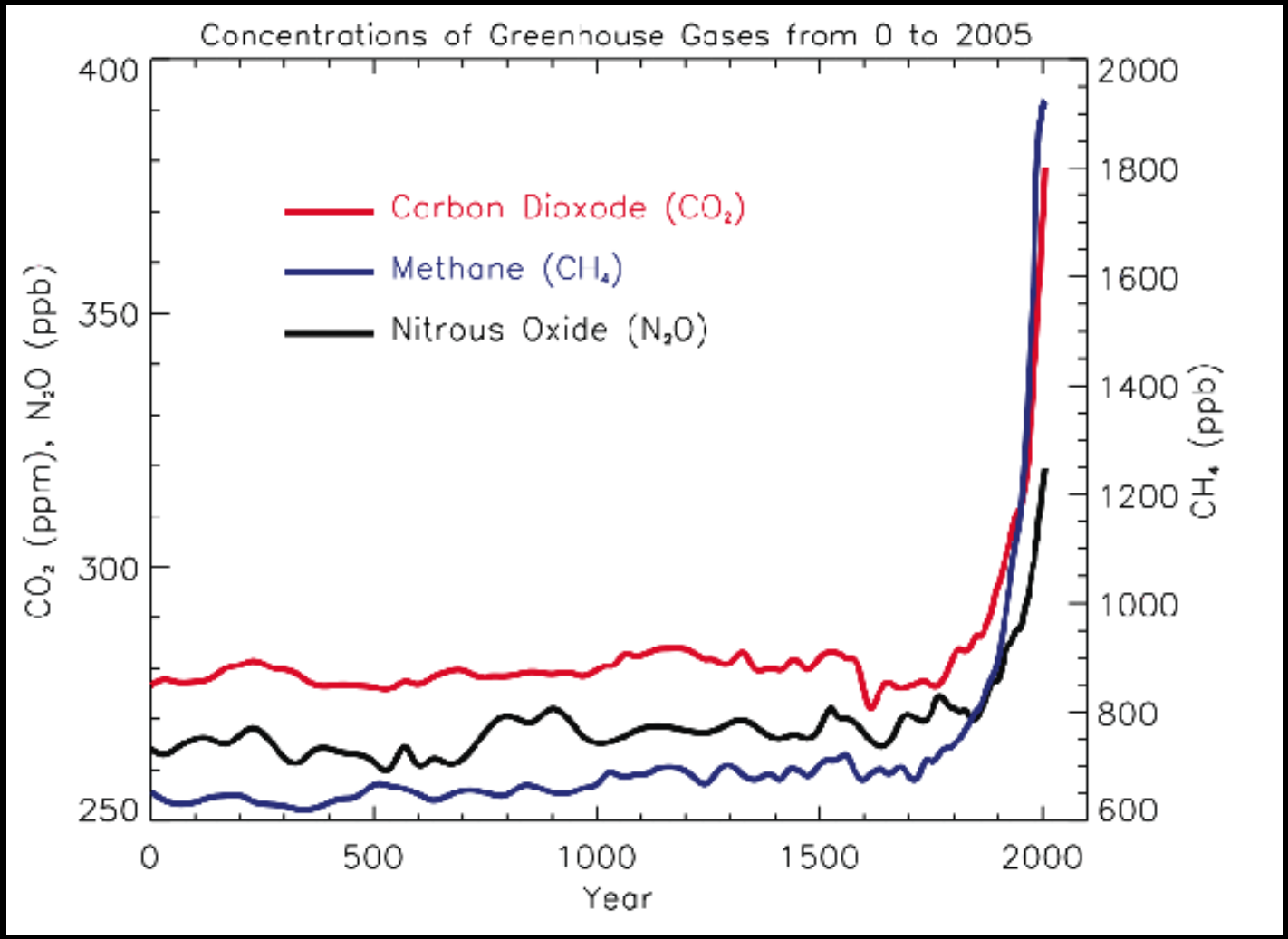
Humankind has grown

- *in number …*
- *in activity …*
- *in impact:* example desertification



Humankind has grown

- *in number …*
- *in activity …*
- *in impact:* *example composition of the atmosphere and climate change*



Humankind has grown

- *in number …*
- *in activity …*
- *in impact:* *example biodiversity and extinction of species*

- *Species have been disappearing at 50-100 times the natural rate.*
- *An estimated 34,000 plant and 5,200 animal species face extinction.*
- *A vast array of domesticated plants and animals is shrinking due to modern commercial agriculture.*
- *~30% of breeds of the main farm animal species are currently at high risk of extinction.*
- *fragmentation, degradation, and loss of forests, wetlands, coral reefs, and other ecosystems threatens biological diversity.*
- *~10% of coral reefs have been destroyed, and ~40% face collapse over the next decades.*

  ~50% of coastal mangroves are gone. (UNCBD).

Humanity has altered the Earth system substantially:

- ~50% of the ice-free Earth surface are transformed, managed, utilized ecosystems
- Human-mobilized material and energy flows are comparable to natural flows

  We have fragmented or eliminated ecosystems, and innumerable species are in decline or already extinct.

  We changed the biosphere significantly over of the last 300 years, and we are creating the greatest extinction crisis since the natural disaster that wiped out the dinosaurs 65 million years ago.

  These extinctions are irreversible and threaten our own well-being.
- The magnitude of human-induced environmental changes at global scale is enormous

We have entered the “Anthropocene”

But we have not learned to wield the power!

We are Facing a Great Challenge, if not Extinction

Guide for "United Nation's Convention on Biological Diversity" :

"It is reckless if not downright dangerous to keep chipping away at our life support system. It is unethical to drive other forms of life to extinction, and thereby deprive present and future generations of options for their survival and development.

Can we save the world's ecosystems, and with them the species we value and the other millions of species, some of which may produce the foods and medicines of tomorrow? The answer will lie in our ability to bring our demands into line with nature's ability to produce what we need and to safely absorb what we throw away."

We are now the Stewards of Planet Earth

Stewardship:

Taking care of something valuable that doesn't belong to us.

We better do a good job
in our progress towards sustainability.

Towards Sustainability: *Intergovernmental Organizations…*

UNFCCC

GEO GROUP ON EARTH OBSERVATIONS

Millennium Development Goals for 2015:

- Eradicate Extreme Poverty and Hunger
- Achieve Universal Primary Education
- Promote Gender Equality and Empower Women
- Reduce Child Mortality
- Improve Maternal Health
- Combat HIV/AIDS, Malaria and other Diseases
- Ensure Environmental Sustainability
- Develop a Global Partnership for Development

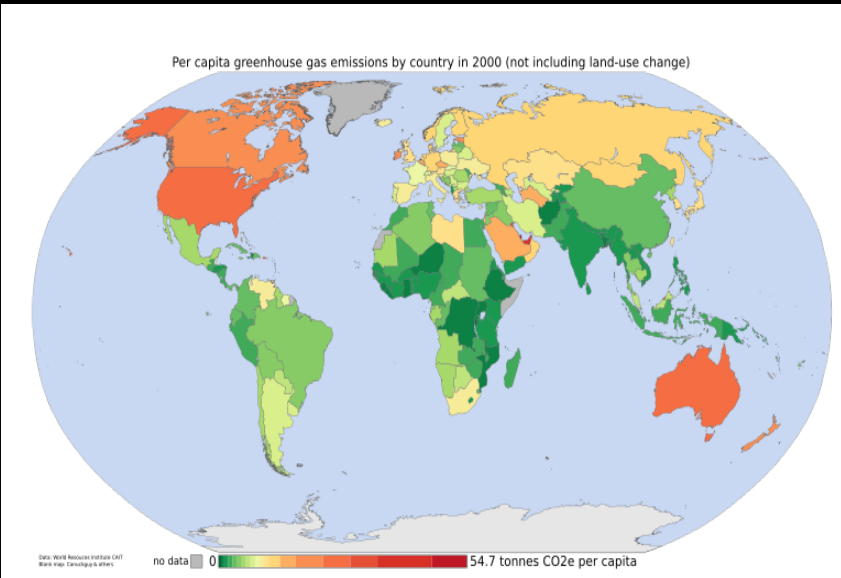
Towards Sustainability: *Non-governmental Organizations…*

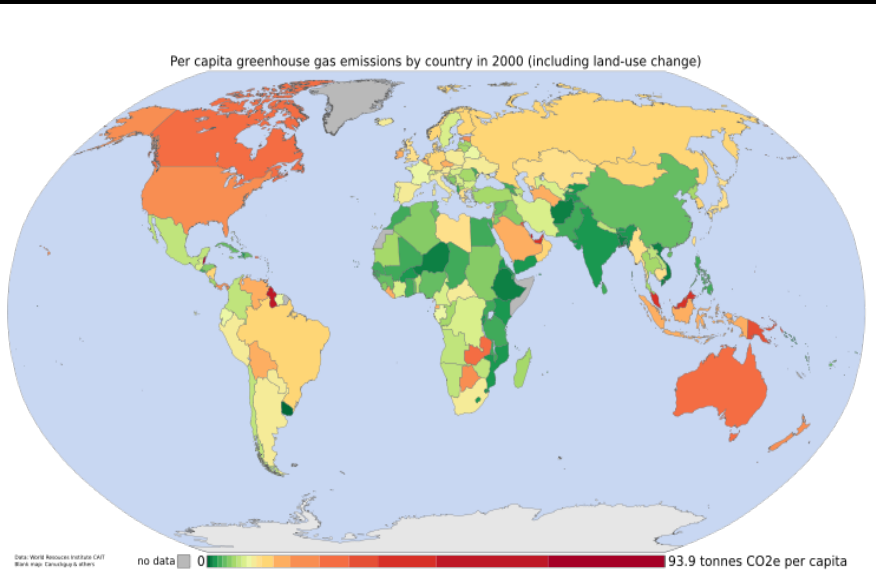
Paul Hawken (2007): *"... there are over one – and maybe even two – million organizations working toward ecological sustainability and social justice."*

Towards Sustainability: *The Metric …*

We have information based on many system indicators, for example:

- Environmental parameters;
- Economic indicators including those on Greenhouse gas emission and Energy usage;
- Societal, political, and governance indicators;
- Recently combined indictors, …





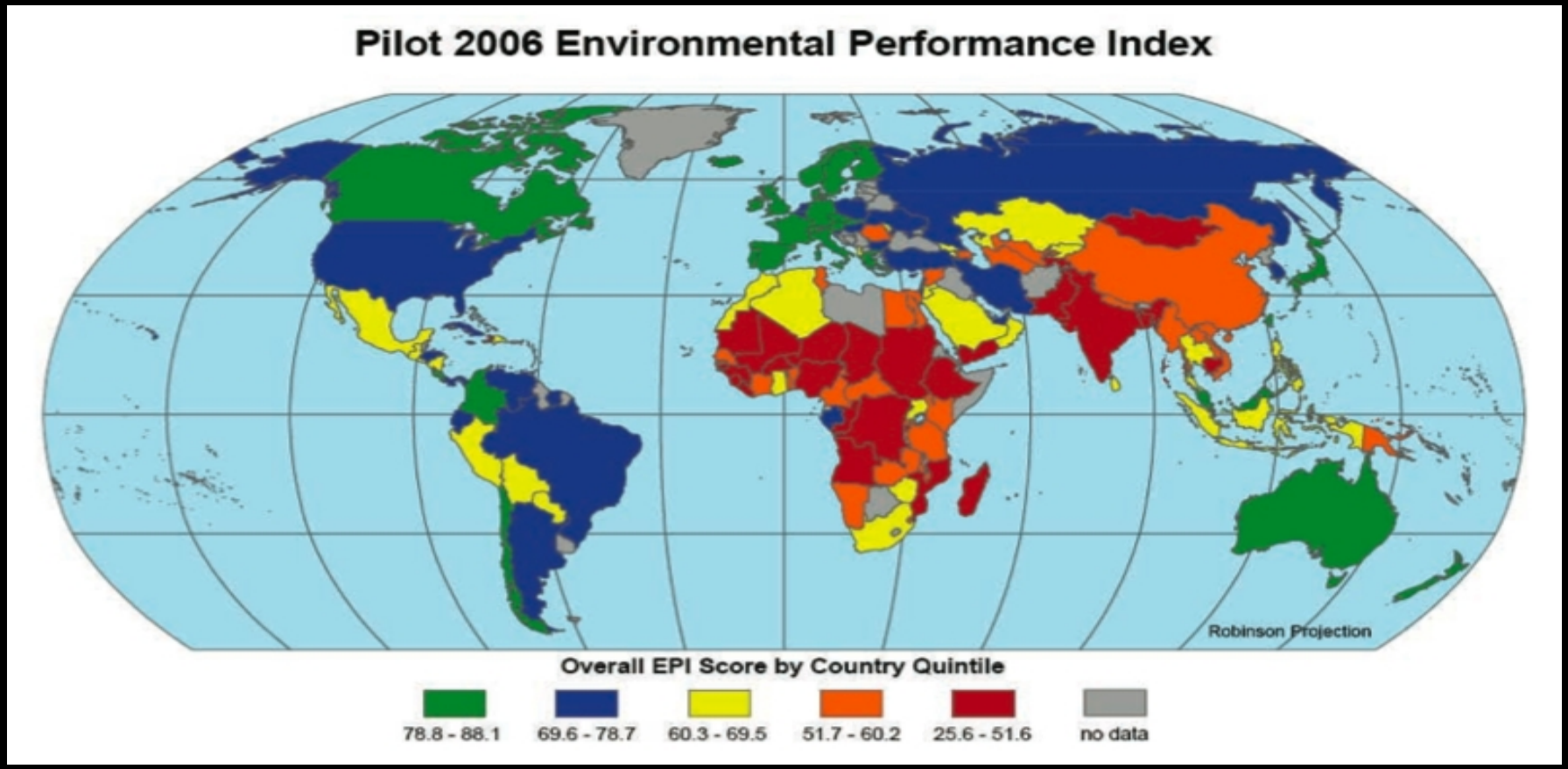
Towards Sustainability: *The Metric …*

Environmental Performance Index (EPI):

Two overarching environmental objectives:

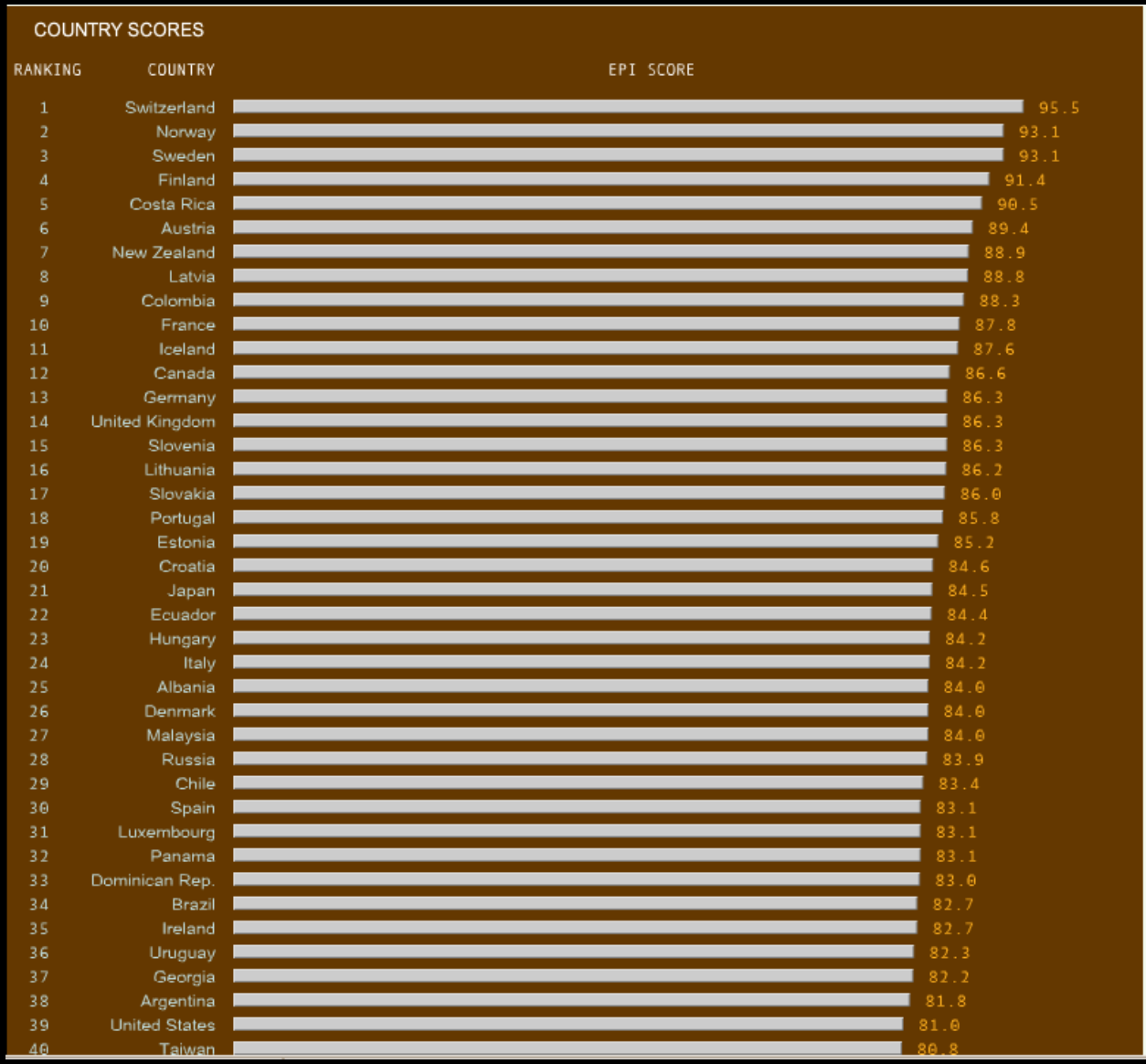
** reducing environmental stresses to human health;*

** promoting ecosystem vitality and sound natural resource management.*



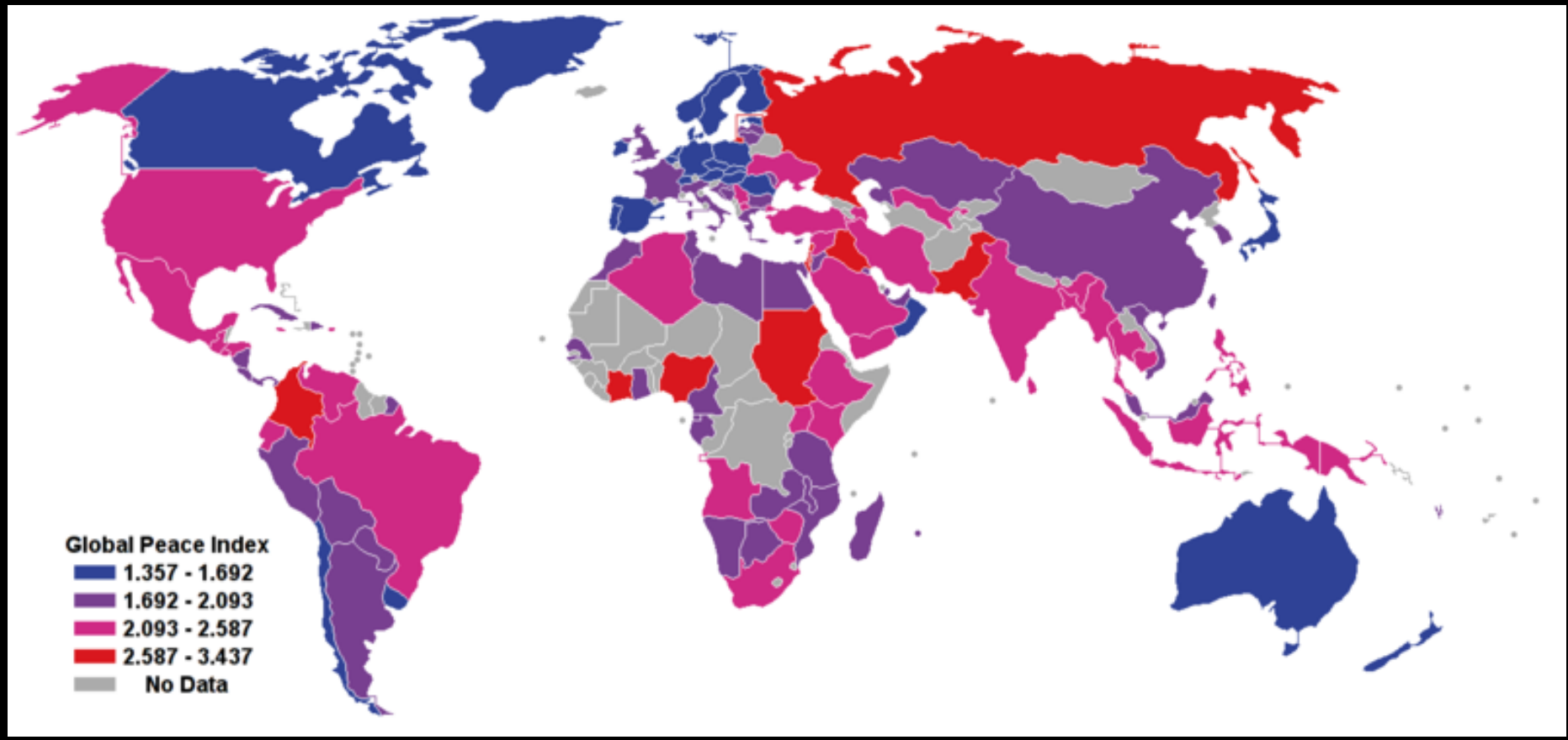
Towards Sustainability: *The Metric …*

Environmental Performance Index (EPI):



Towards Sustainability: *The Metric …*

Global Peace Index: *measures countries' peacefulness based on 24 external and internal indicators.*



Towards Sustainability: *The Environmental Challenges …*

Environmental challenges include:

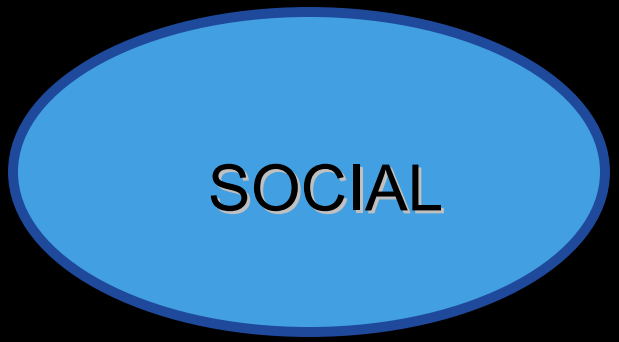
- *deforestation;*
- *disasters;*
- *desertification;*
- *extinction of species;*
- *climate change, …*

Reasonable approach: precautionary principle

Towards Sustainability: *The Social Challenges …*

Social challenges include:

- *population growth;*
- *education;*
- *poverty;*
- *gender equality;*
- *health;*
- *diversity, anxieties, intolerance, racism;*
- *peace, …*



Millennium development goals: After more than half way through, we are still far from achieving these important goals.

Towards Sustainability: *The Economic Challenges …*

Economic challenges include:

- *production;*
- *waste;*
- *economic accounting;*
- *space planning and infrastructure;*
- *water;*
- *food;*
- *energy, …*

Towards Sustainability: *The Economic Challenges …*

Production: we need a "remaking of the way we make things"

Currently production:

- puts billions of pounds of toxic material into air, water and soil every year;
- produces material so dangerous they will require constant vigilance;
- results in gigantic amounts of waste;
- puts valuable materials irretrievably in holes all over the planet;
- requires thousands of complex regulations to keep people from being poisoned too quickly;
- measures productivity by how few people are working;
- creates prosperity by degrading natural resources;
- erodes the diversity of species and cultural practices.

(*modified from McDonough and Baumgart, 2002*)

Future "Good" Design would includes:

- Something we can use with clear consciences;
- Free of guilt about how it was made or sold, and how we get rid of it;
- Longevity of products;
- "Cradle to cradle" instead of "cradle to death".

Towards Sustainability: *The Economic Challenges …*

Water: We need good governance

United Nations (2006) World Water Development Report 2 - *Water, a shared Responsibility*:

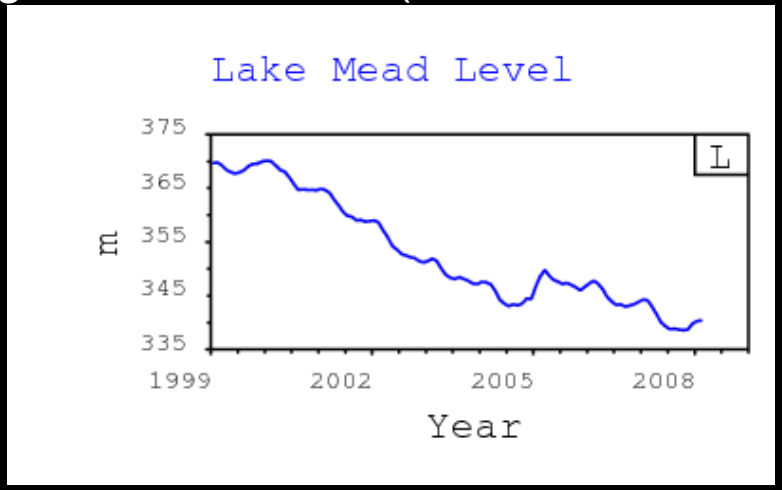
- "There is enough water for everyone. The problem we face today is largely one of governance: equitably sharing this water while ensuring the sustainability of natural ecosystems. At this point in time, we have not yet achieved this balance."
- "Decisions on water management are a top priority. Who has the right to water and its benefits? Who is making water allocation decisions on who is supplied with water - and from where, when and how?"

Towards Sustainability: *The Economic Challenges …*

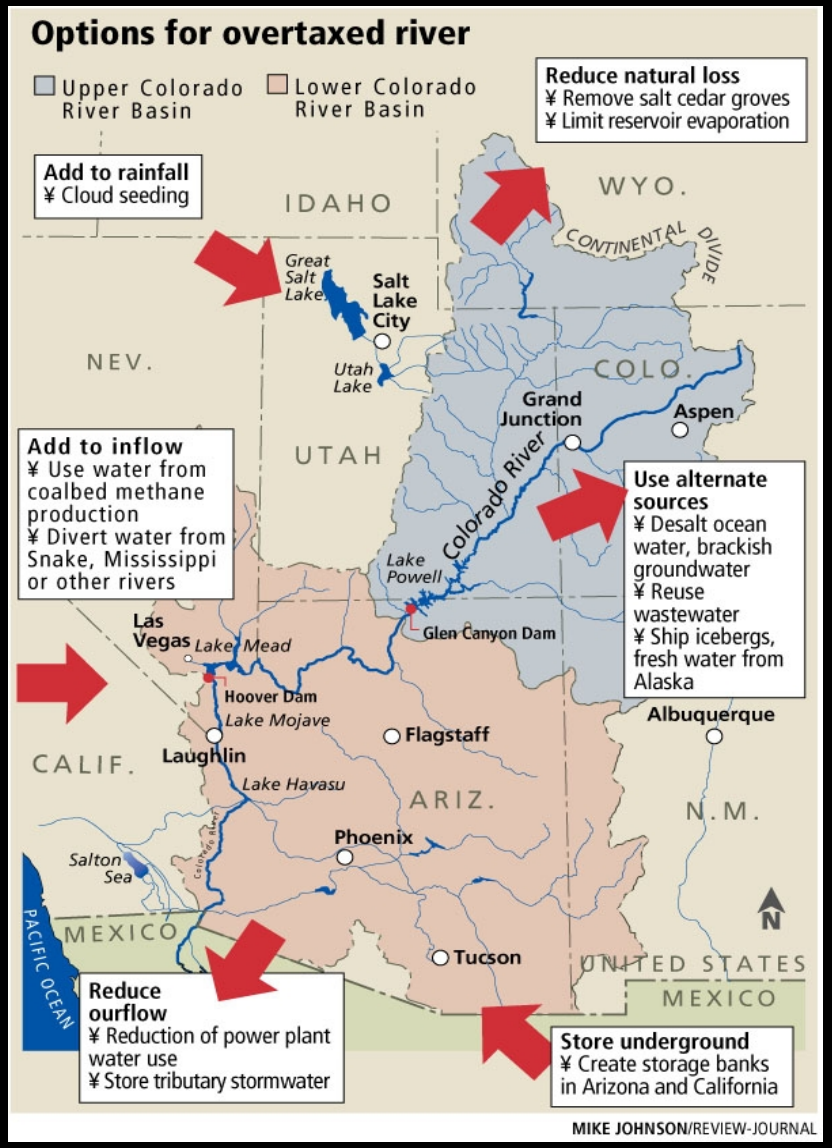
Water: We need good governance

Example: Colorado River Basin:

- Many proposed solutions for the governance problem (*Las Vegas Review Journal, 2008/03/31*);
- Lake Mead and Lake Powell may dry out by 2021 (50% chance) with useable water gone much earlier (*Pearce et al., 2008*);



- Lost more than 6 cu.km in the last 10 years
- How is surrounding groundwater affected?

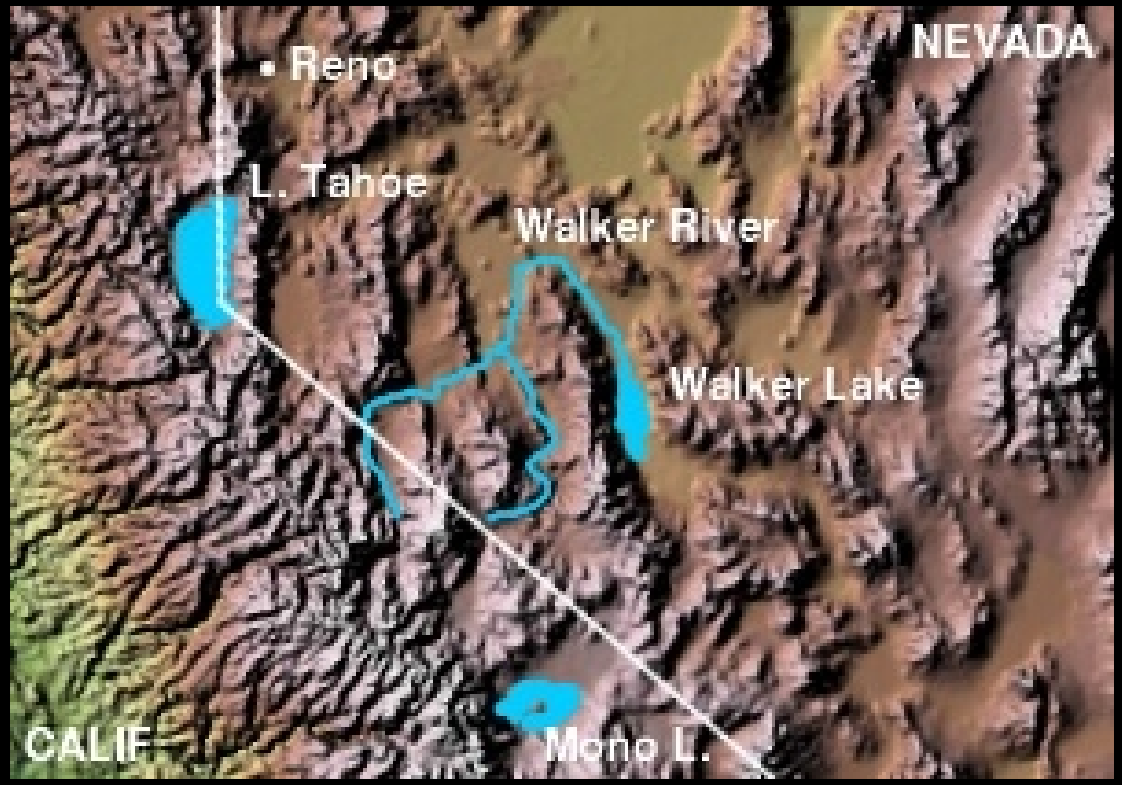


Towards Sustainability: *The Economic Challenges …*

Water: We need good governance

Example: Walker Lake management

- UNR involved in Walker Basin Project (http://www.nevada.edu/walker);
- Comprehensive research-based project to sustain the basin's economy, ecosystem, and lake.

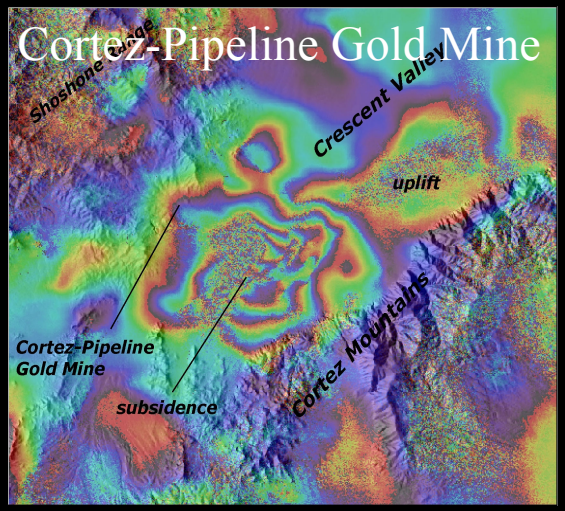


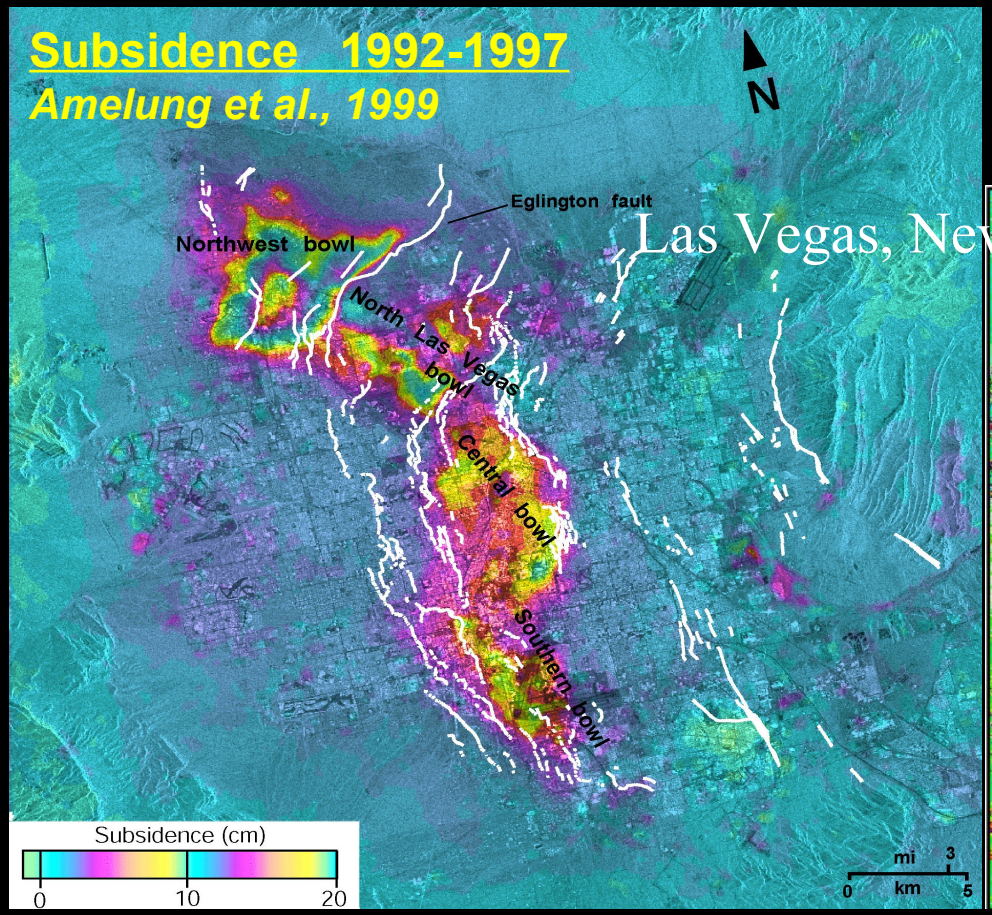
Towards Sustainability: *The Economic Challenges …*

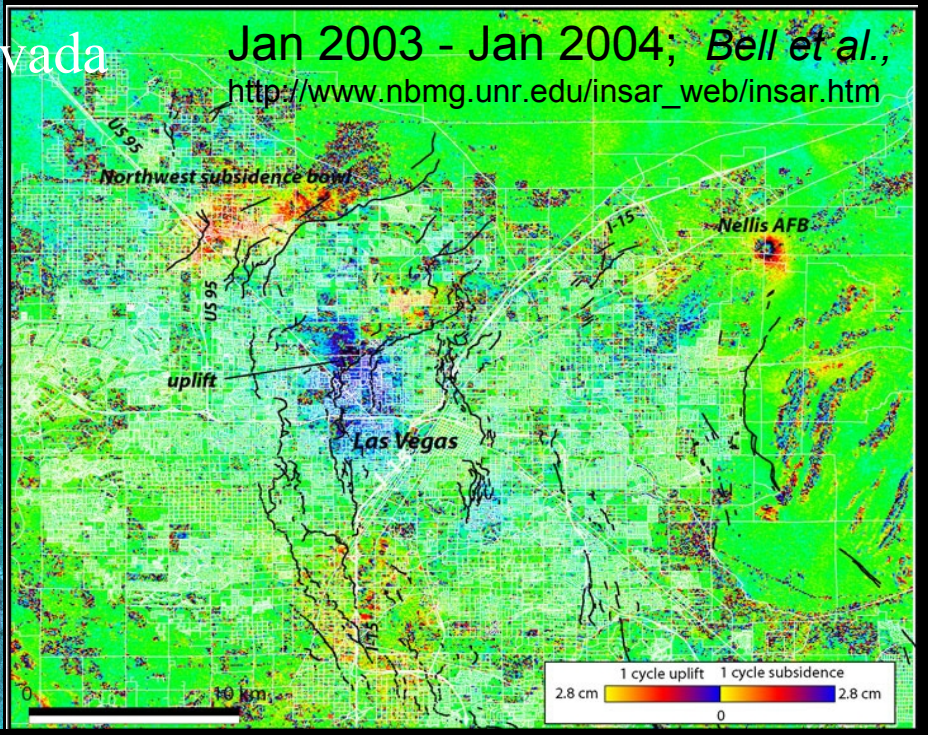
Water: We need good governance

Example: Water management in Nevada

- UNR provides expertise and observations



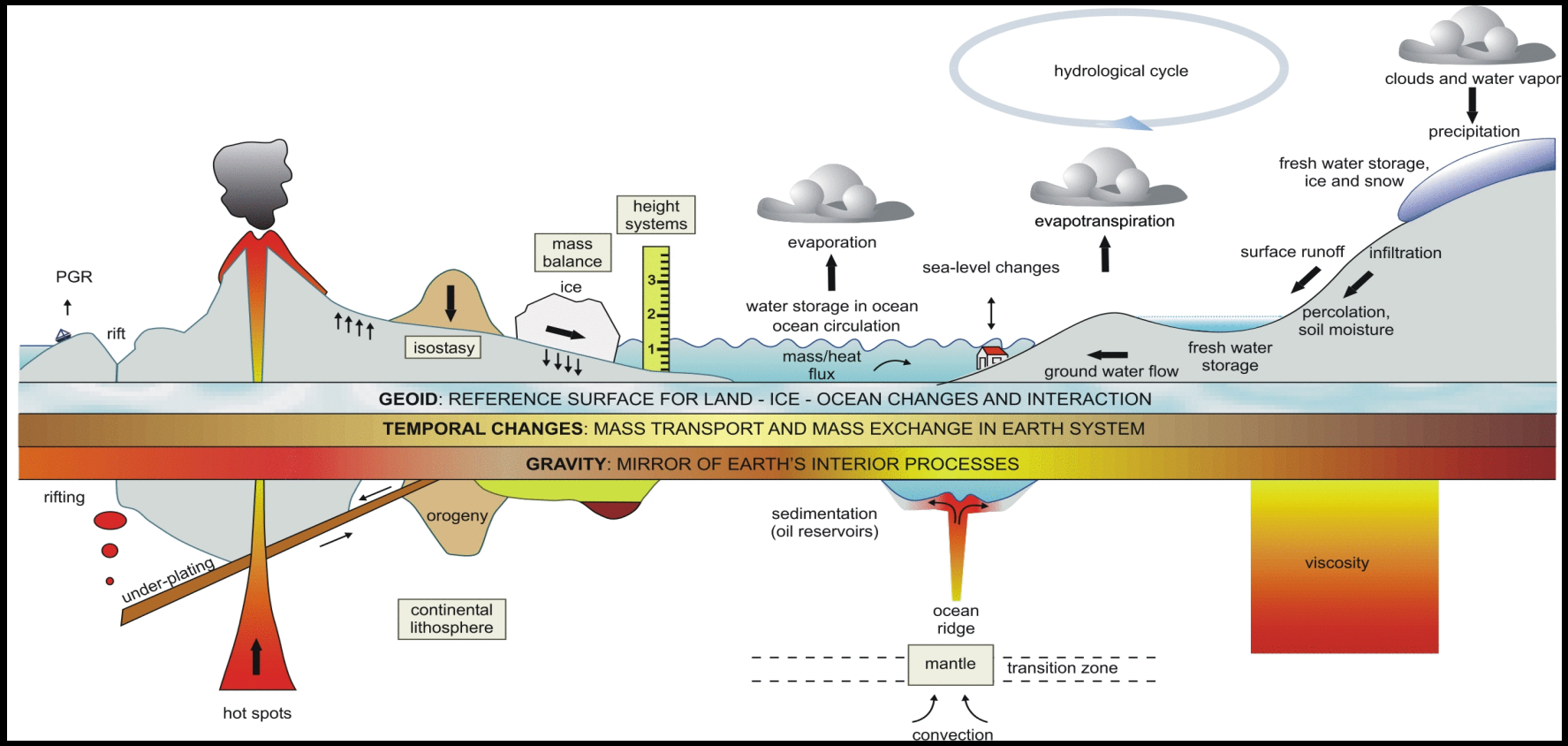




Towards Sustainability: *The Economic Challenges …*

Water: We need good governance

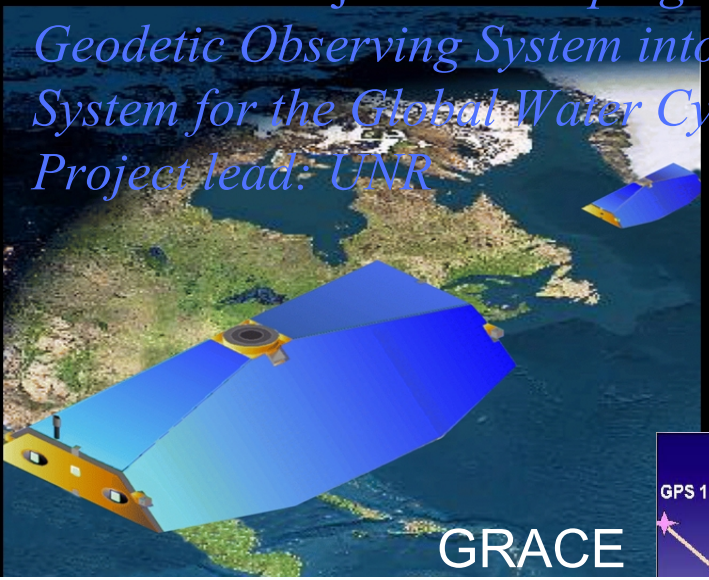
Example: Observing the Water Cycle …

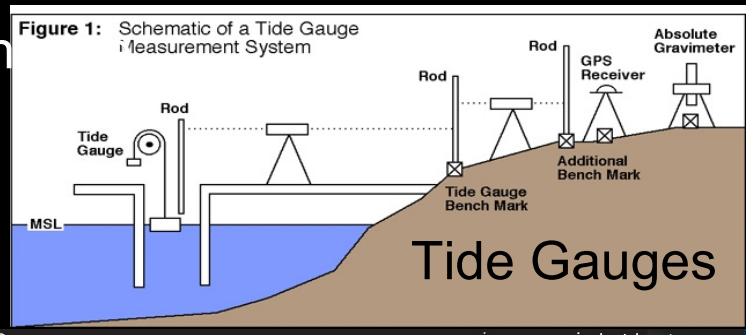


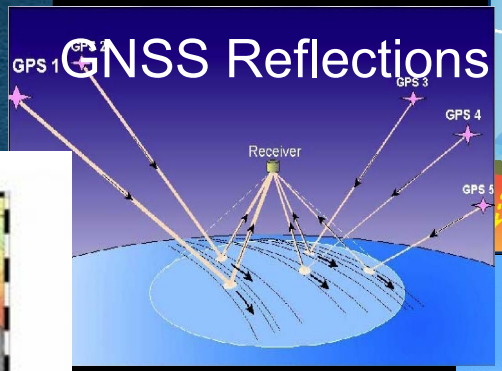
Towards Sustainability: *The Economic Challenges …*

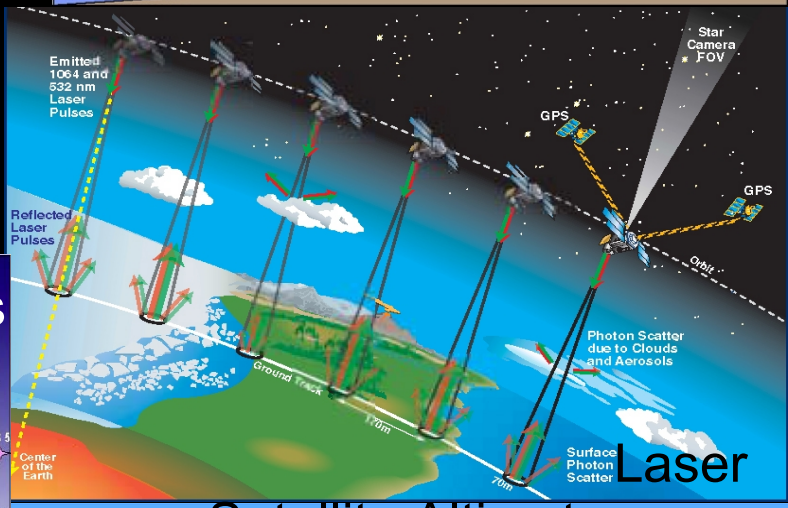
Water: We need good govern

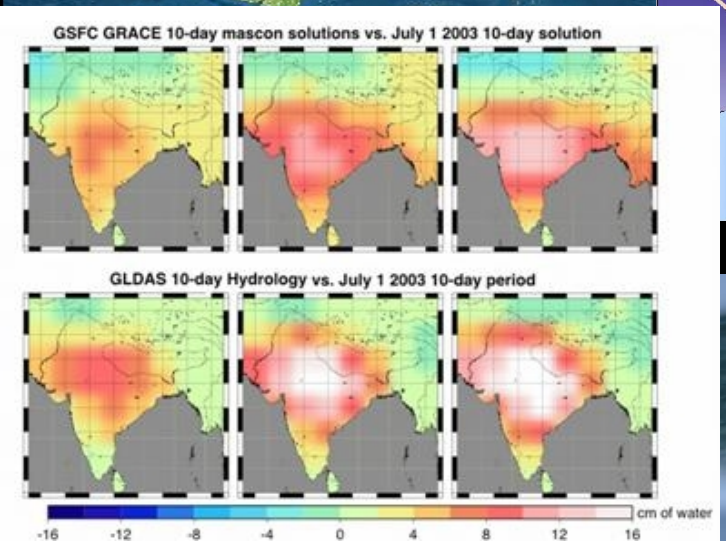
IGCP 565 Project: *Developing the Global Geodetic Observing System into a Monitoring System for the Global Water Cycle*
Project lead: UNR



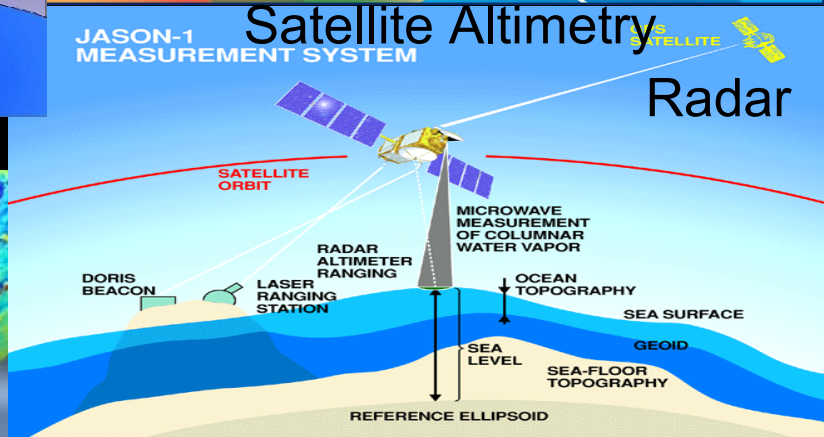








Satellite Altimetry



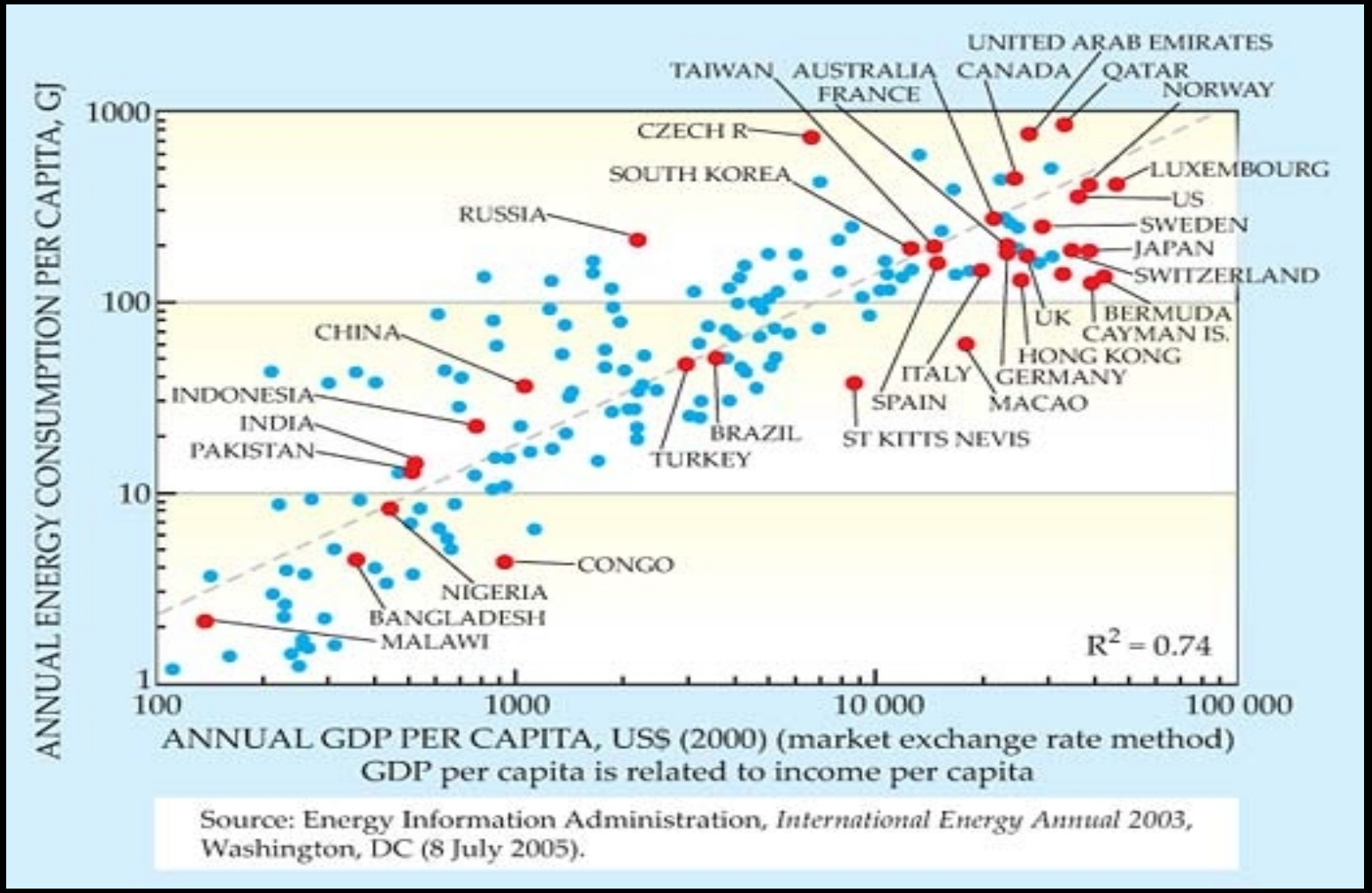
Towards Sustainability: *The Economic Challenges …*

Energy:

- energy efficiency;
- complete transition to renewable energy sources.

Towards Sustainability: *The Economic Challenges …*

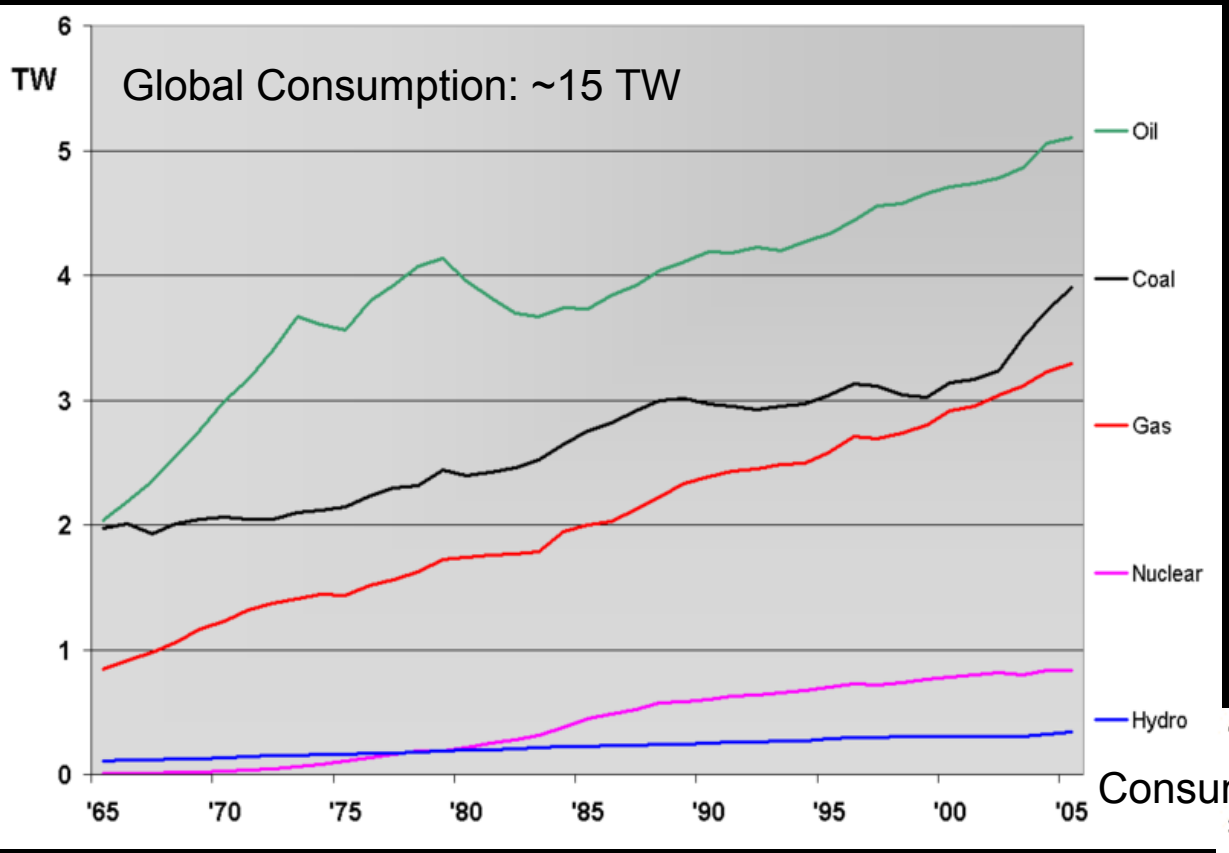
Energy usage and GDP

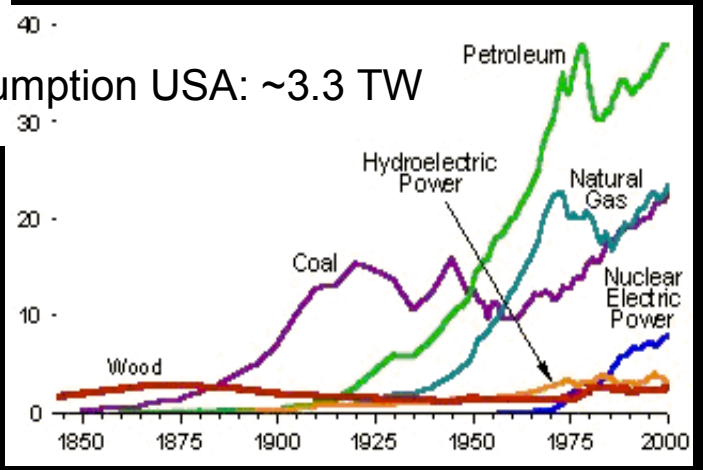


Energy per capita/GDP per capita: ~3 to ~200 MJ/$

Towards Sustainability: *The Economic Challenges …*

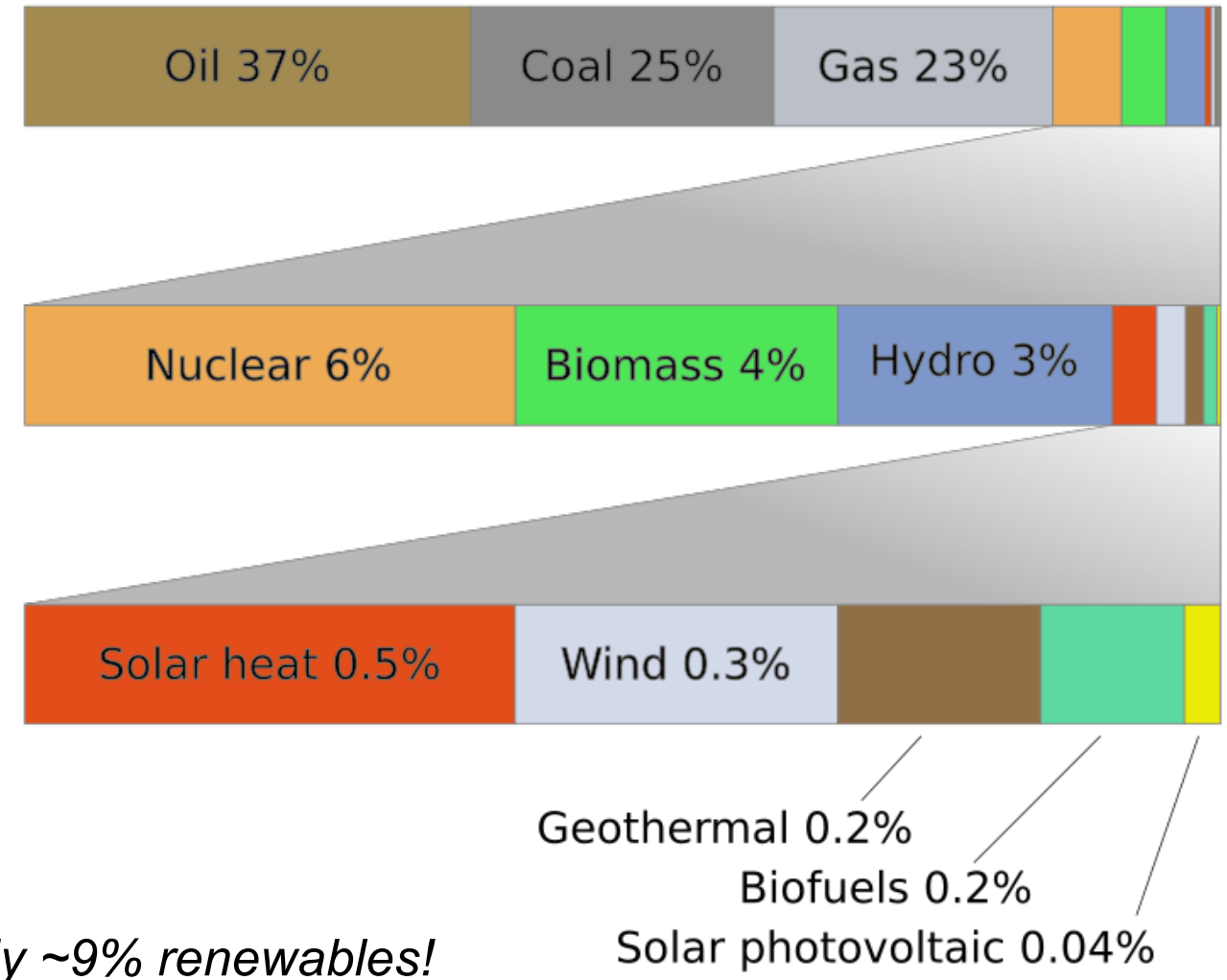
Energy sources and consumption





Towards Sustainability: *The Economic Challenges …*

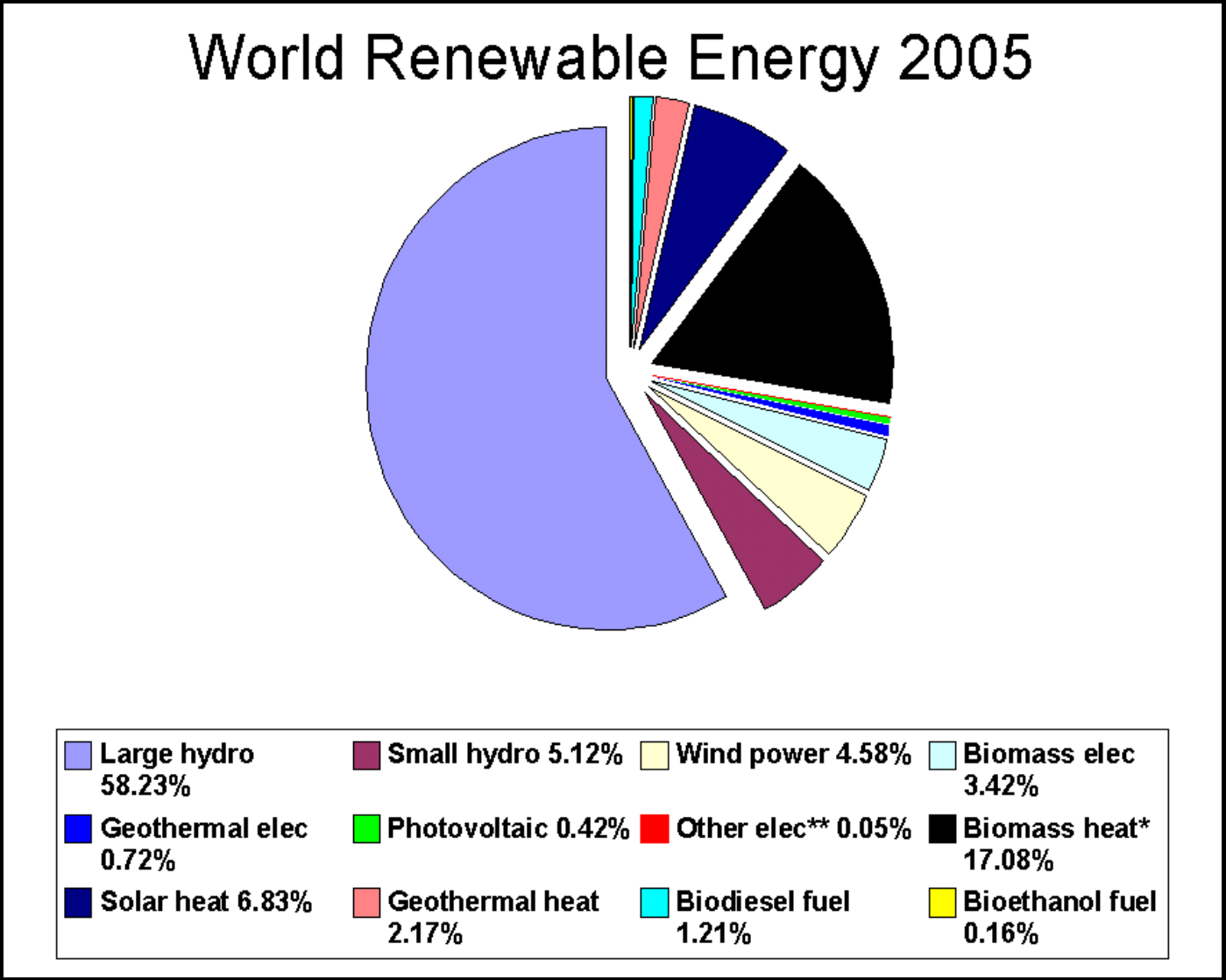
The Global Energy Mix



Only ~9% renewables!

Towards Sustainability: *The Economic Challenges …*

The Global Energy Mix: Renewables



Towards Sustainability: *The Economic Challenges …*

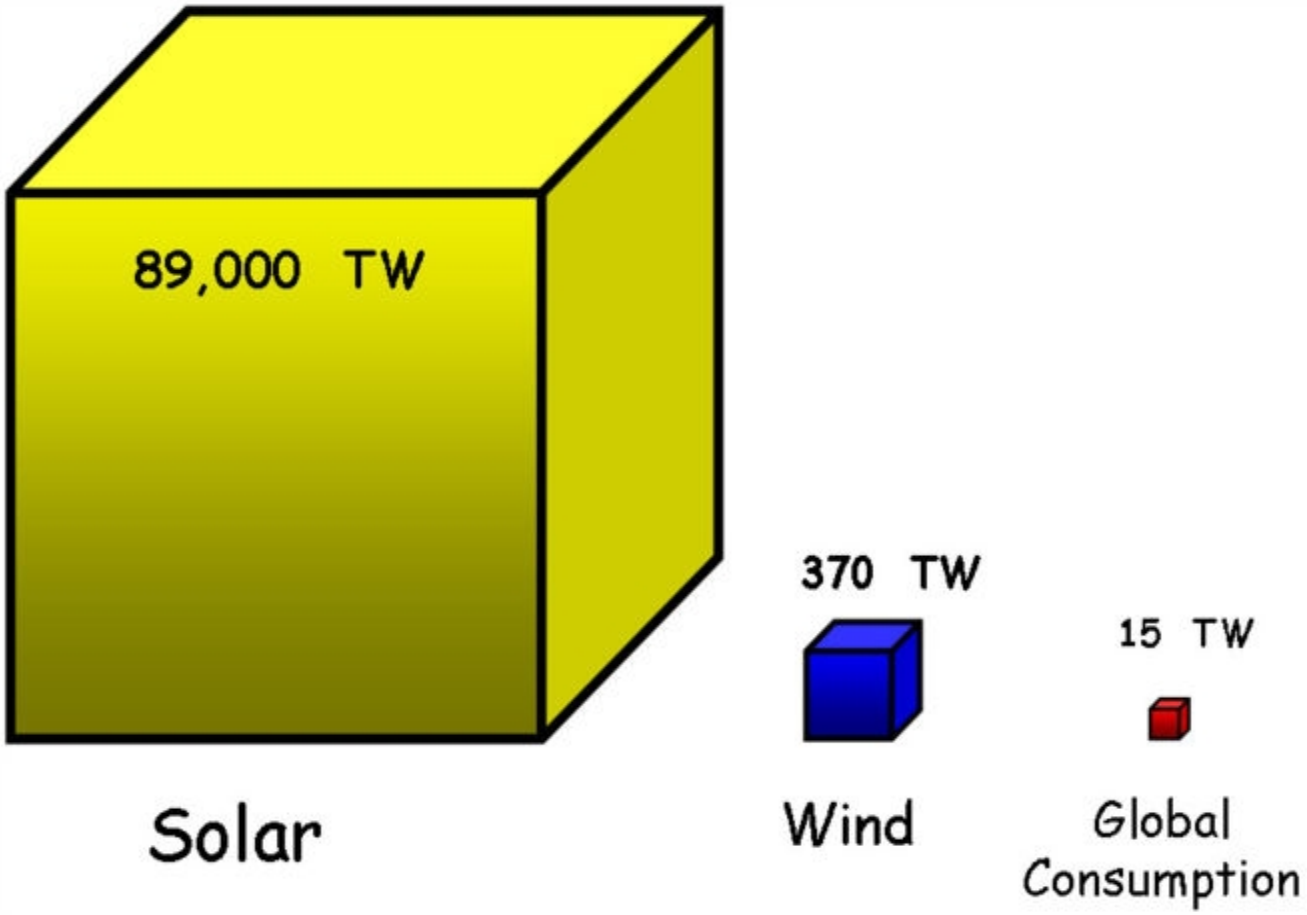
Energy: Steps in the right direction?

Biofuels

Crude palm oil at a Malaysian biodiesel plant. The EU plans to ban some biofuels. (Zainal Abd Halim/Reuters)

Towards Sustainability: *The Economic Challenges …*

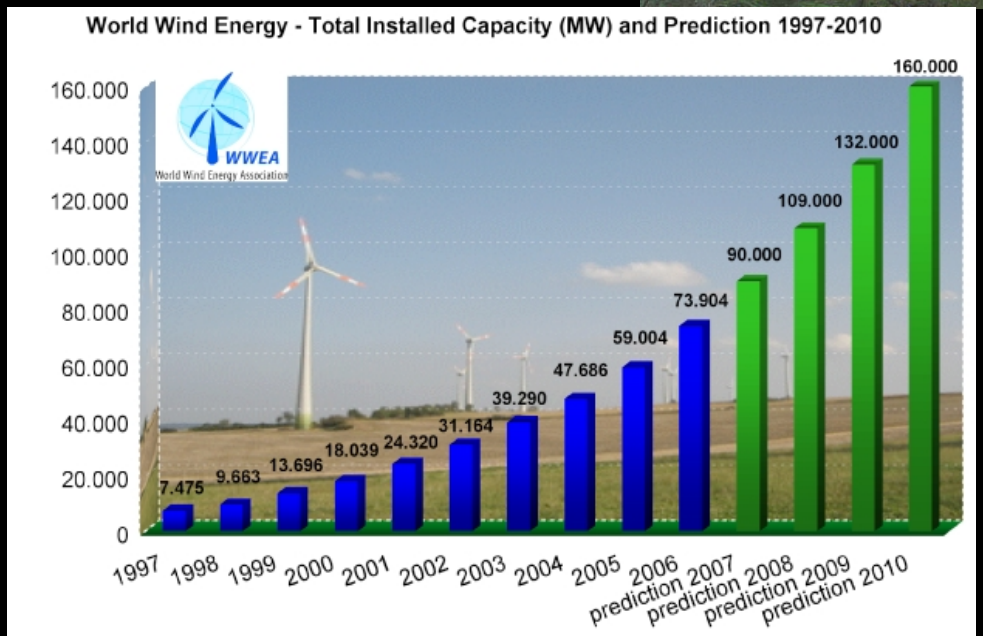
Relation of renewable sources to consumption



Towards Sustainability: *The Economic Challenges …*

Energy: Steps in the right direction …

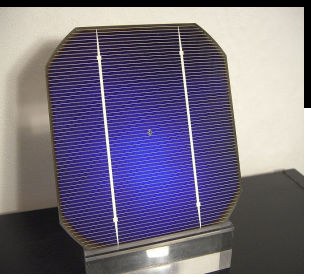
Wind Energy



Towards Sustainability: *The Economic Challenges …*

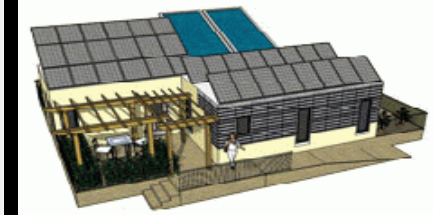
Energy: Steps in the right direction …

Solar Energy

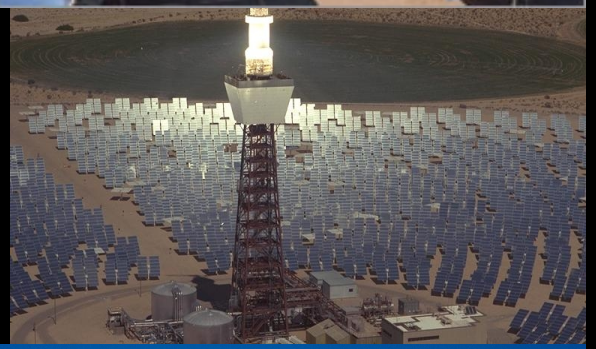


First Place: Technische Universität Darmstadt

Second Place: University of Maryland



Third Place: Santa Clara University



Towards Sustainability: *The Economic Challenges …*

Energy: Steps in the right direction

Solar-energy based hydrogen society

- Much is in research stage
- Many technological problems, many proposed solutions

"Three test flights of the two-seater aircraft took place in February and March at an airfield at Ocana, south of Madrid." *BBC, April 4, 2008.*

Towards Sustainability: *The Economic Challenges …*

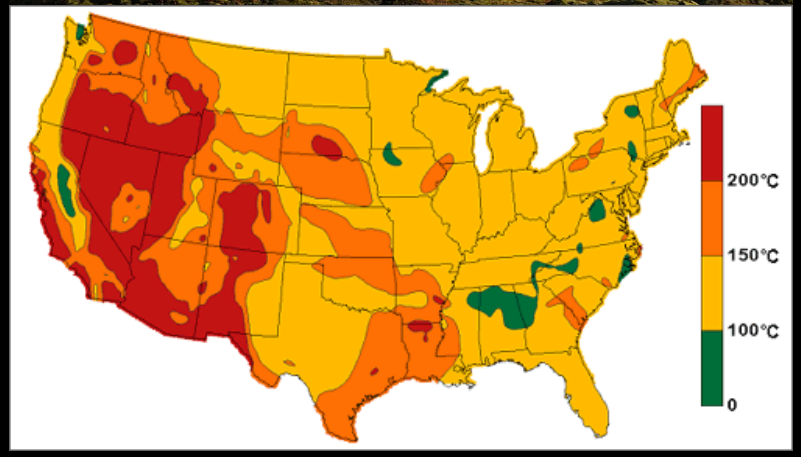
Energy: Steps in the right direction …

Geothermal Energy

great potential

Extractable energy sufficient for many thousand years

Some associated environmental problems



Heat pumps:

air-source systems

geothermal systems - 40,000 geothermal heat pumps installed in the United States each year.

Towards Sustainability: *The Economic Challenges …*

Energy: Steps in the right direction …

Geothermal Energy at UNR:

Great Basin Center for Geothermal Energy

Mission: ... to work in partnership with U. S. industry to establish geothermal energy as a sustainable, environmentally sound, economically competitive contributor to energy supply in the United States.

- Initiated in 2002
- Applied research in collaboration with industry
  - identify and evaluate new and emerging technologies
  - explore for and assess geothermal resources
- Outreach/Training/Education
- Provide needed and timely information
- Have developed international reputation

Towards Sustainability: *Where do we stand?*

We know that the current development is not sustainable;
We need a "quantum leap" towards sustainability very soon;
We have a good ethical principle and political concept;
We have a good metric and much of the information we need;
We have technological and conceptual solutions.

But in general we do not act accordingly.

Our common value system does not support progress towards sustainability.

There is no "silver bullet" that would solve the problem once and for all.

We need many small steps in the right direction!

Sustainability: *What can you do now?*

a small step …

Towards Sustainability: *What can you do now?*

Towards Sustainability: *What can you do now?*

Some examples in your personnel life:

- Make sure, Off is off;
- Reduce, then reuse, then recycle;
- Look for the energy star;
- Stop washing dishes by hand;
- Compost;
- Look for local food and products;
- Power the grid.

Some examples in your social life:

- Reach out to your neighbors;
- Get involved in your local school;
- Join an environmental advocacy group;
- Run for town council or higher, put yourself out in the public eye;
- Vote for eco-friendly policies and candidates.

Towards Sustainability: *What can you do now?*

Some examples in your work life:

- Start or join a sustainability/green task force;
- Make machines last;
- Use less and/or recycled paper;
- Conduct a waste audit;
- Switch off the lights.

Towards Sustainability: *What can we do now?*

Our leaders need to make small steps in the right direction:

- Heads of schools, colleges, universities and their department;
- Business leaders, leaders of organizations;
- Leaders of towns, cities, counties, and states;
- National and international leaders.

We need to ensure that they go in the right direction.

Only if we choose the leaders who understand the challenge can we hope that eventually the future will be now.

Towards Sustainability: *Can we make it?*

There is hope …

We can do it:
with many small steps in the right direction,
we can make the “quantum leap”.