

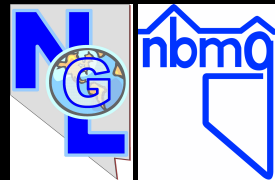
UNR and SUSTAINABILITY: Some General Considerations and Specific Ideas for Small Steps in the Right Direction

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University of Nevada, Reno
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SUSTAINABILITY:

A Mosaic of Many Small Steps in the Right Direction

Available at

<http://geodesy.unr.edu/hanspeterplag/sustainability/>

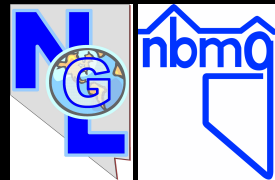
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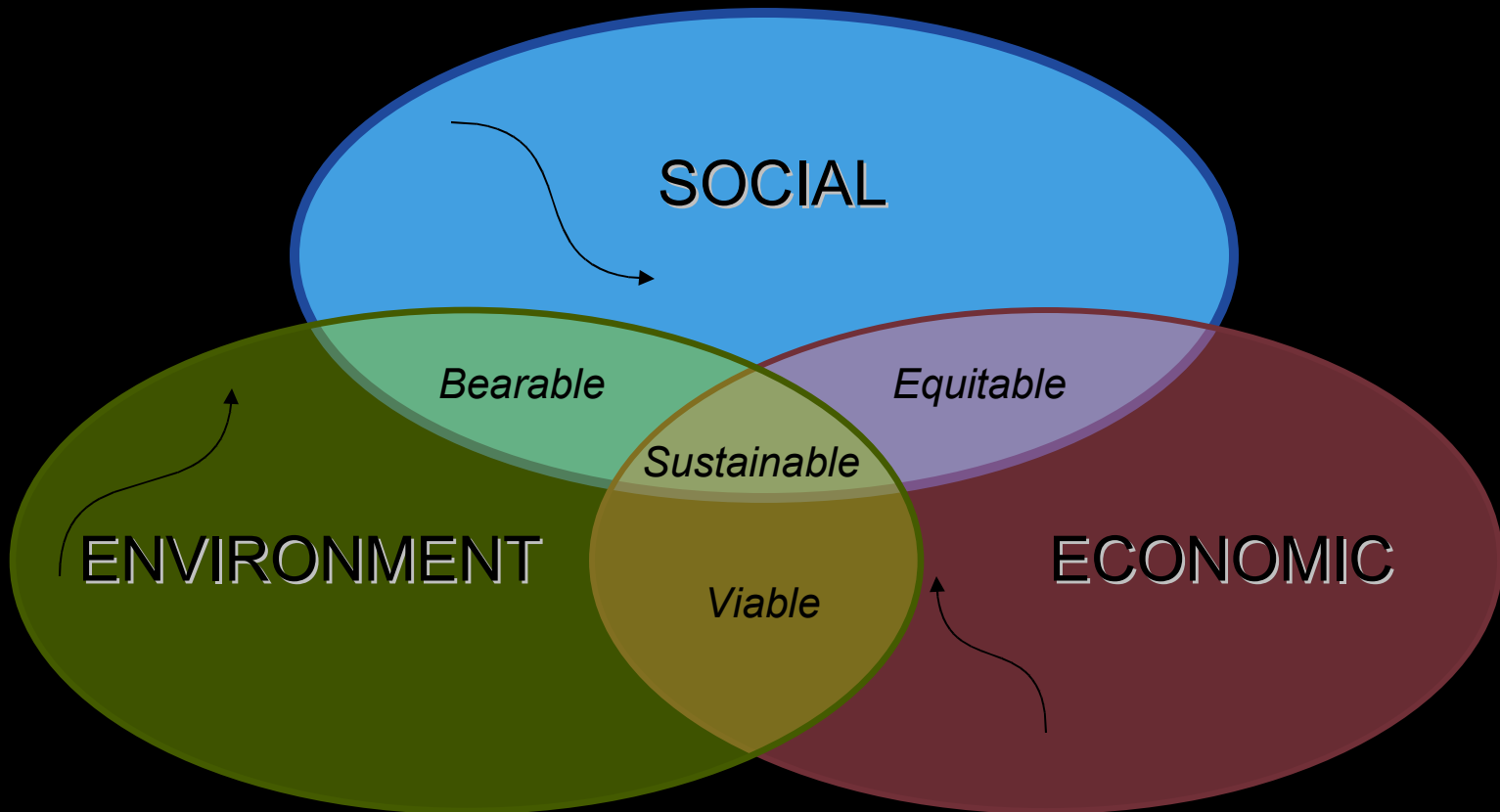


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SUSTAINABILITY:

“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

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.

Quantitative Definition:

- Life expectancy of the system,
- trajectories of certain factors.

Questions related to Operationalization:

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

How are we in this world?

Earth is a very special planet ...



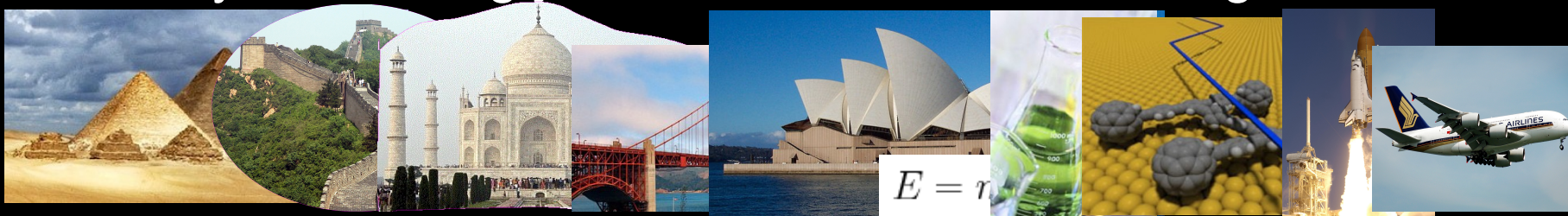
Earth is a living planet ...



Earth has an anthroposphere ...



Humanity is amazingly active, creative, and intelligent... .



Humanity is dysfunctional and destructive... .

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

How are we in this world?

Earth is a very special planet ...

Earth is a living planet ...

Earth has an anthroposphere ...

Humanity is amazingly active, creative and intelligent ...

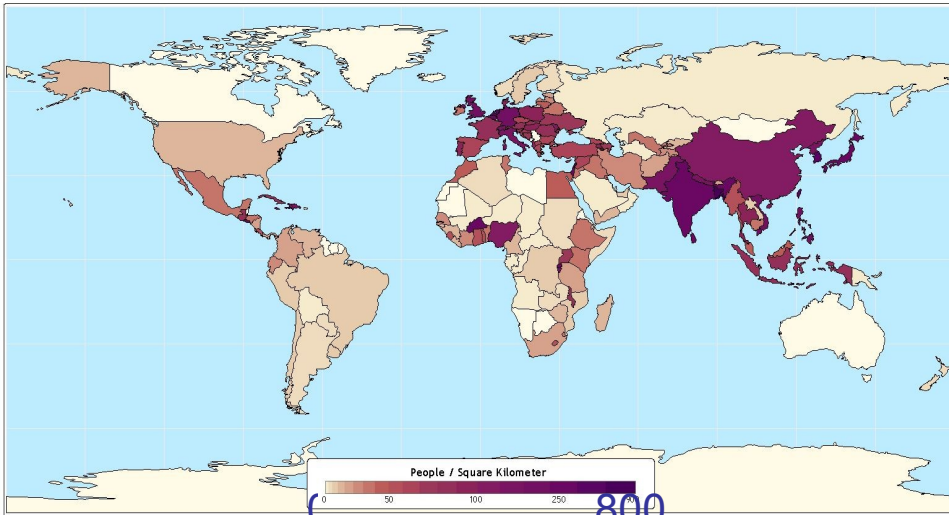
Humanity is dysfunctional and destructive ...

Humankind has grown ...

Humankind has grown

- in number ...

Population Density by Country

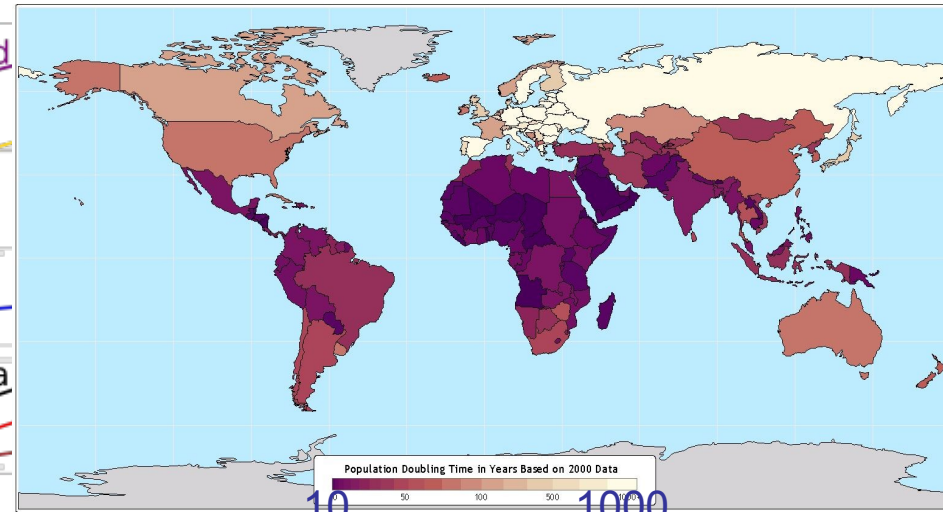


Data taken from: ESRI (2000)

Atlas of the Biosphere

Center for Sustainability and the Global Environment
University of Wisconsin - Madison

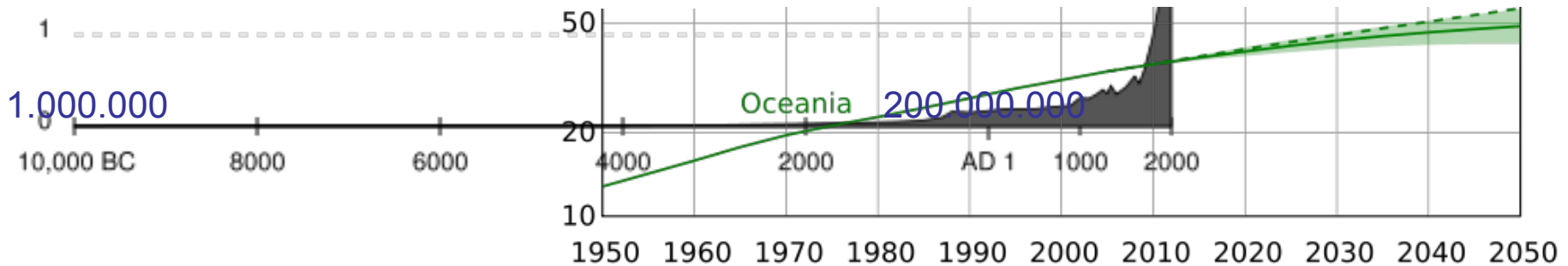
Population Doubling Time



Data taken from: Population Reference Bureau (2000)

Atlas of the Biosphere

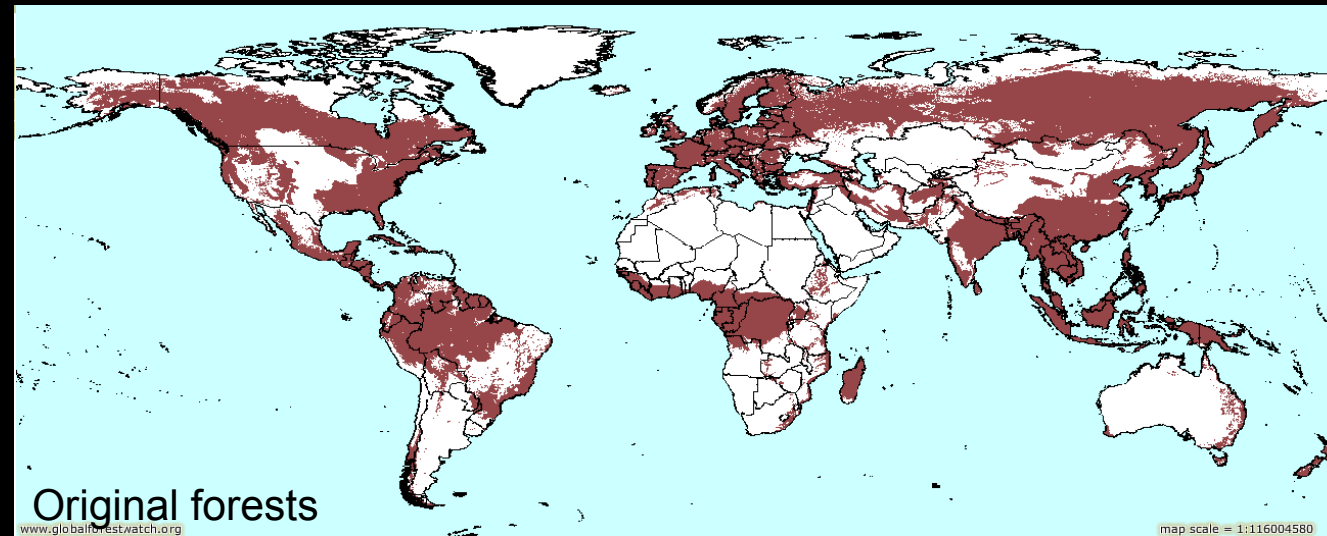
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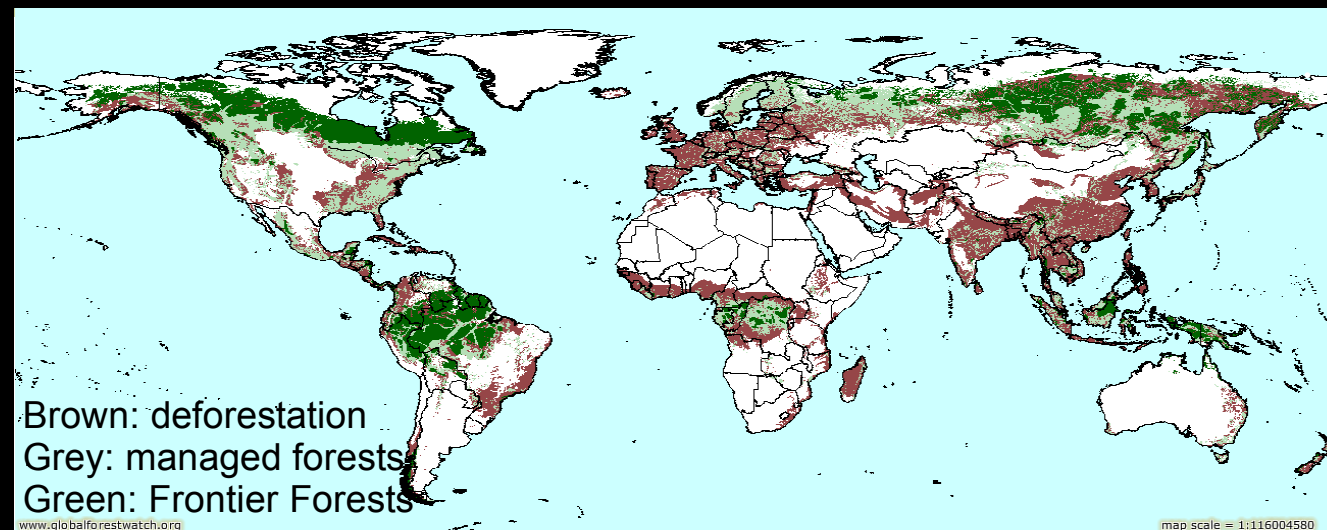
Humankind has grown

- *in number* ...

- *in activity*: example deforestation...



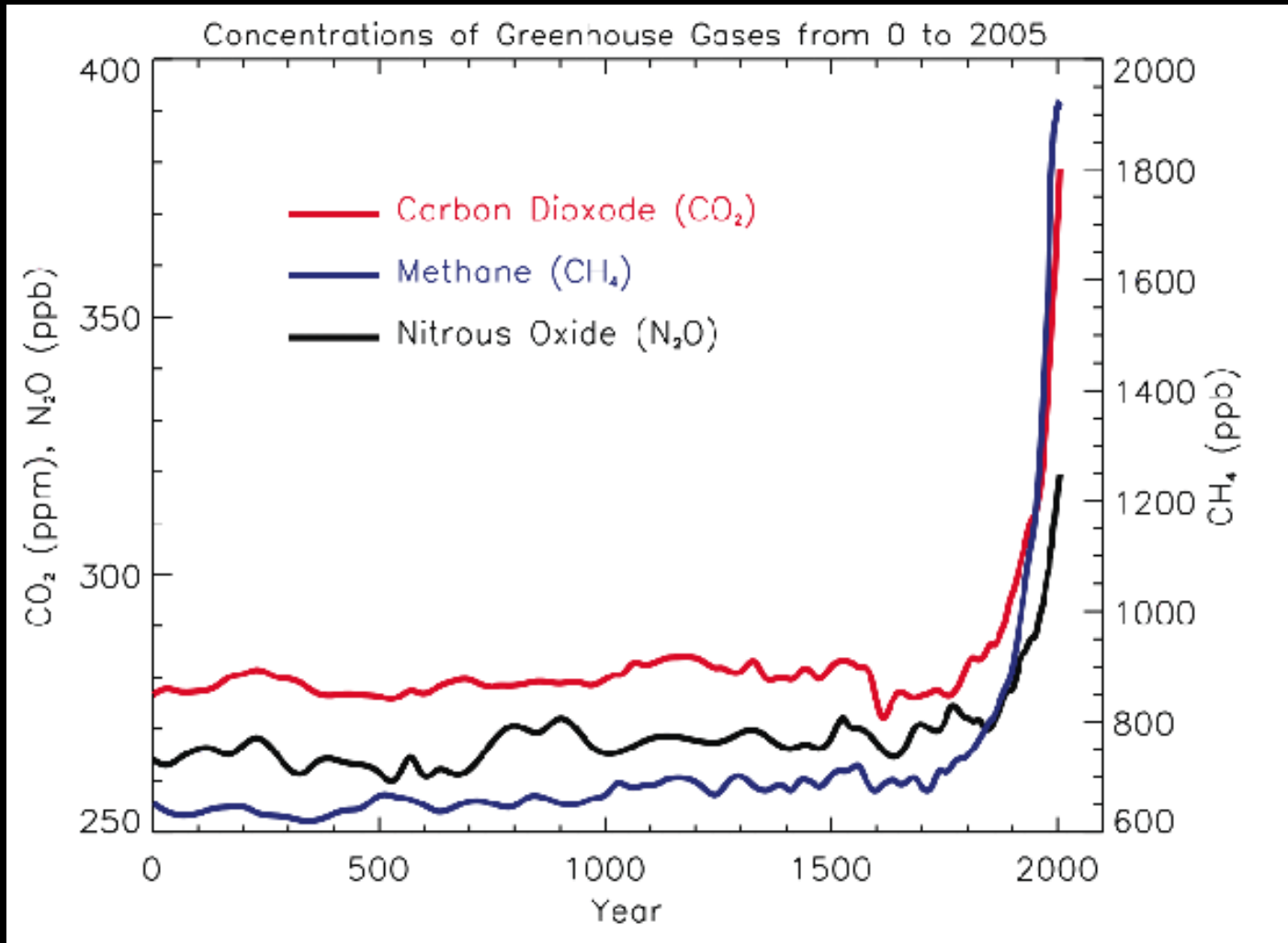
- About 50% of the original forests are gone;
- Only 20% of frontier forests remain



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

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 now the Stewards of Planet Earth

Stewardship:

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

We are Facing a Great Challenge, if not Extinction

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

Towards Sustainability:

Intergovernmental organizations: UN, Convention on Biodiversity, UNFCCC, IPCC, Millennium Development goals, GEO, ...

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

Metric: increasing number of sustainability indicators covering social, economic and environmental aspects.

Challenges: better understanding and increased awareness of the environmental, social, and economic problems hampering sustainability.

Towards Sustainability: *The Environmental Challenges ...*

Environmental challenges include:

- *extinction of species;*
- *deforestation;*
- *climate change;*
- *desertification;*
- *Disasters, ...*



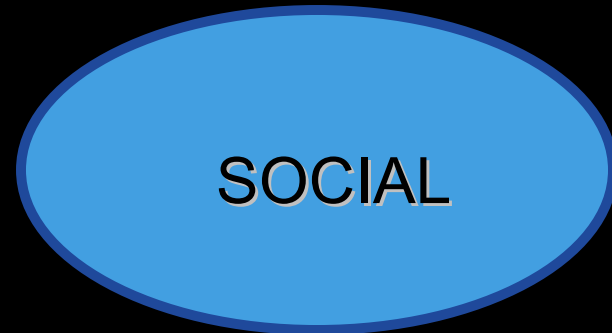
ENVIRONMENT

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: remaking the way we make things*
- *waste;*
- *economic accounting;*
- *space planning and infrastructure;*
- *water;*
- *food;*
- *energy, ...*



ECONOMIC

Towards Sustainability: *Where do we stand?*

*We know that the current development is not sustainable;
We have a good ethical principle and political concept;
We have a good metric and much of the information we need;
We know and understand the challenges;
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 a “quantum leap” towards sustainability very soon.

We need many small steps in the right direction!

A University Focused on Sustainability

Educating the stewards of tomorrow ...

Educating the Stewards of Tomorrow ...

Teaching sustainability:

- Integrating sustainability issues (every)where appropriate;
- **Core curriculum:** *At UNR: modifying core humanity, for example, by including a course on sustainable humanity;*
- Education for underprivileged groups, including developing countries.

Educating the Stewards of Tomorrow ...

Raising awareness:

- Campus events centered around sustainability issues;
- A green pledge for students and faculty

Example: The 2008 Stony Brook University
Campus and Community Green Pledge:



“I pledge to use the knowledge and skills that I have acquired to improve and sustain the natural world and resources around me. Furthermore I pledge to minimize the impact of my ecological footprint and promise to take action to fulfill this commitment.”

A University Focused on Sustainability

Educating the stewards of tomorrow ...

Conducting research in support of sustainability ...

Conducting Research in Support of Sustainability

Understanding the interactions of humanity and the environment;

Developing social, environmental, and economic concepts;

Improving existing and developing new technologies;

Capacity building through joint international projects;

A University Focused on Sustainability

Educating the stewards of tomorrow:

Conducting research in support of sustainability:

Being an example of social, environmental and economic sustainability;

Being an Example of Social, Environmental and Economic Sustainability

For example, leading in sustainable buildings, energy use, waste management, use of resources, operations, ...



Being an Example of Social, Environmental and Economic Sustainability

For example, leading in sustainable buildings, energy use, waste management, use of resources, operations ...

On UNR Level:

- Use renewable energy sources;
- Power the grid;
- Reduce energy usage;
- Look for the energy star;
- Conduct a waste audit;
- Make machines last;

On individual Level:

- Make sure, Off is off;
- Reduce, then reuse, then recycle;
- Use less and/or recycled paper;
- Switch off the lights.





a small step ...

A University focused on Sustainability

Educating the stewards of tomorrow:

Conducting research in support of sustainability:

Being an example of social, environmental and economic sustainability;

Supporting society with science for sound public policy decisions;

A University focused on Sustainability

Educating the stewards of tomorrow:

Conducting research in support of sustainability:

Being an example of social, environmental and economic sustainability;

Supporting society with science for sound public policy decisions;

Outreach to the citizen scientist.

The End

Towards Sustainability: *Intergovernmental Organizations...*



THE Global Earth Observation System of Systems



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...*



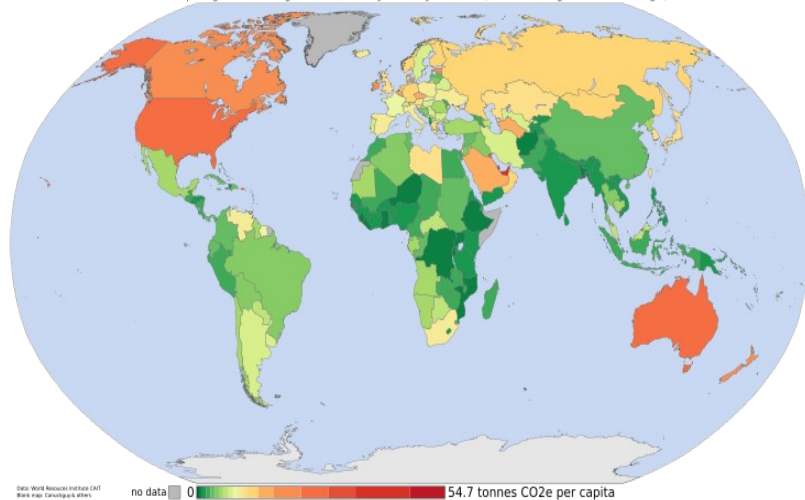
Paul Hawken (2007): “... there are over one – and maybe even two – million organizations working toward ecological sustainability and social justice.”

Towards Sustainability: *The Metric ...*

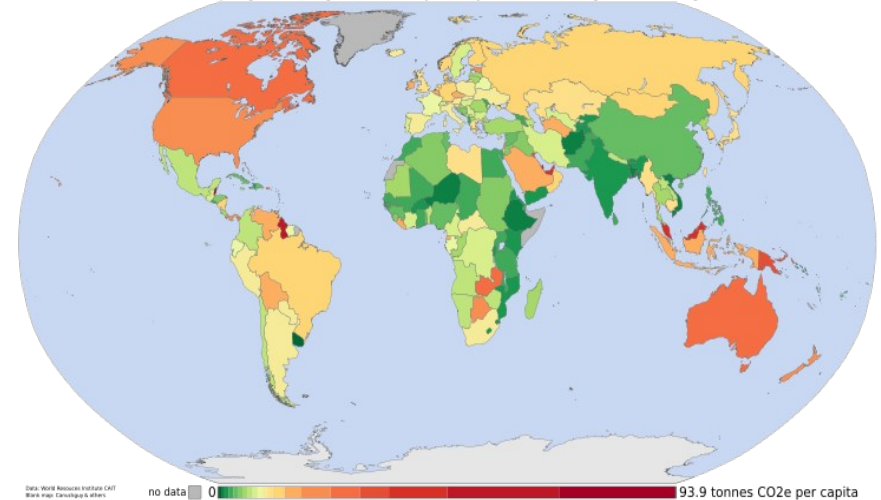
We have information based on many system indicators, for example:

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

Per capita greenhouse gas emissions by country in 2000 (not including land-use change)



Per capita greenhouse gas emissions by country in 2000 (including land-use change)



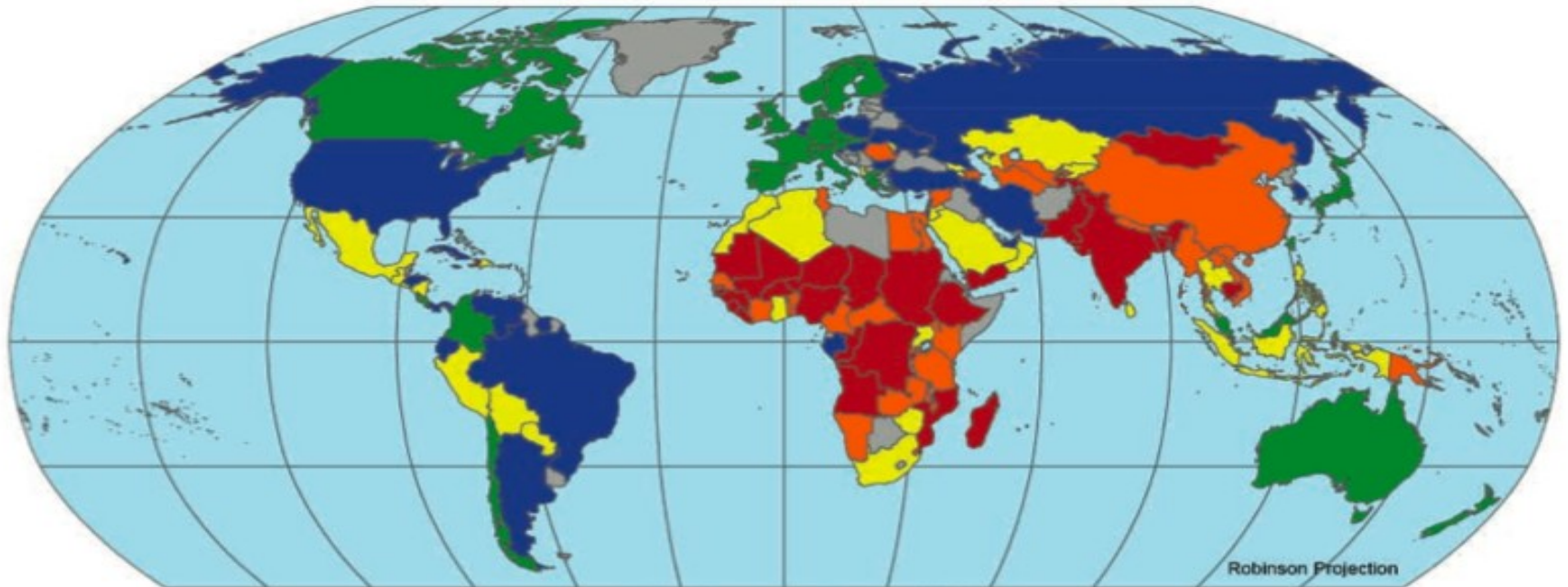
Towards Sustainability: *The Metric ...*

Environmental Performance Index (EPI):

Two overarching environmental objectives:

- * reducing environmental stresses to human health;*
- * promoting ecosystem vitality and sound natural resource management.*

Pilot 2006 Environmental Performance Index

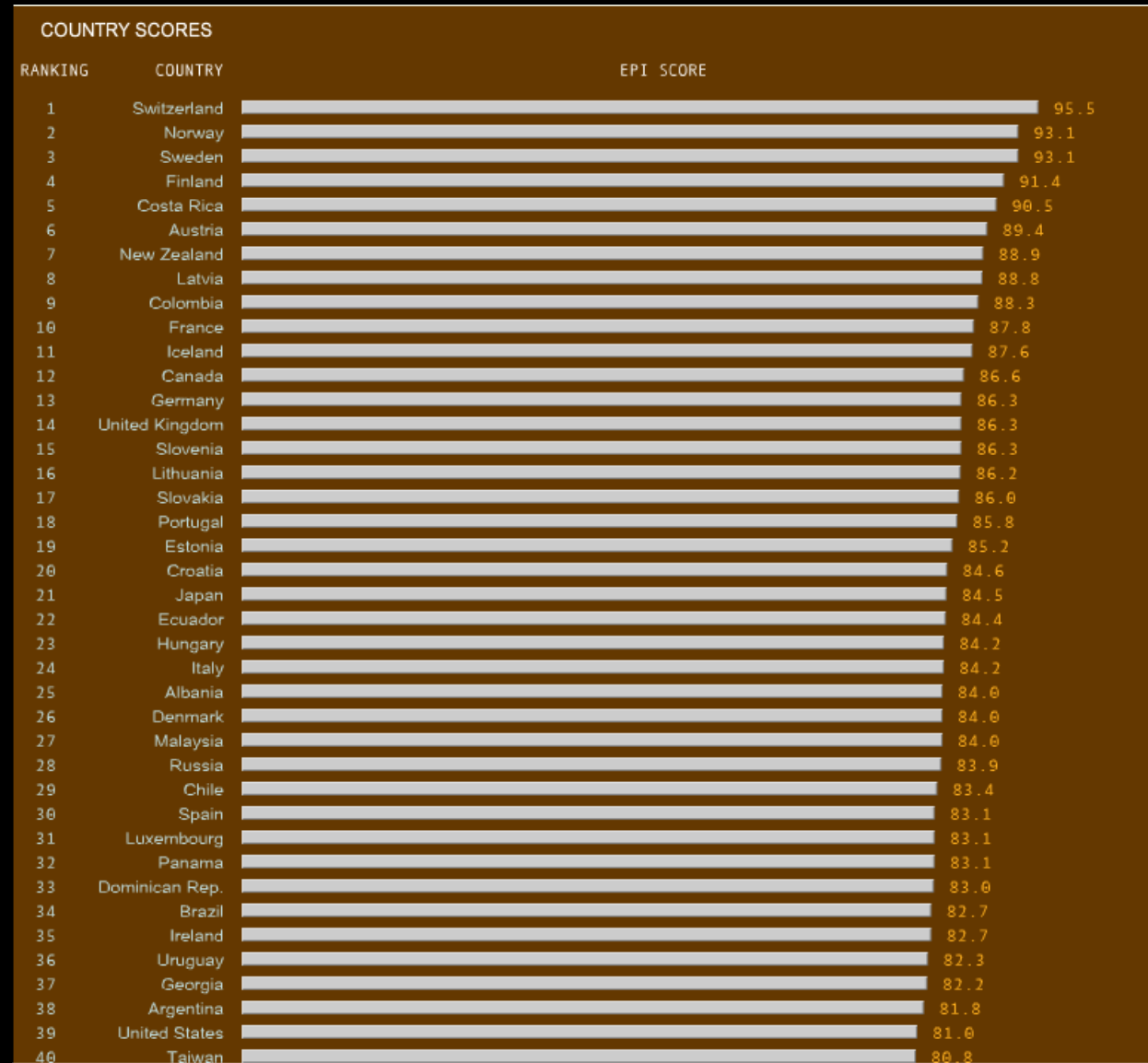


Overall EPI Score by Country Quintile



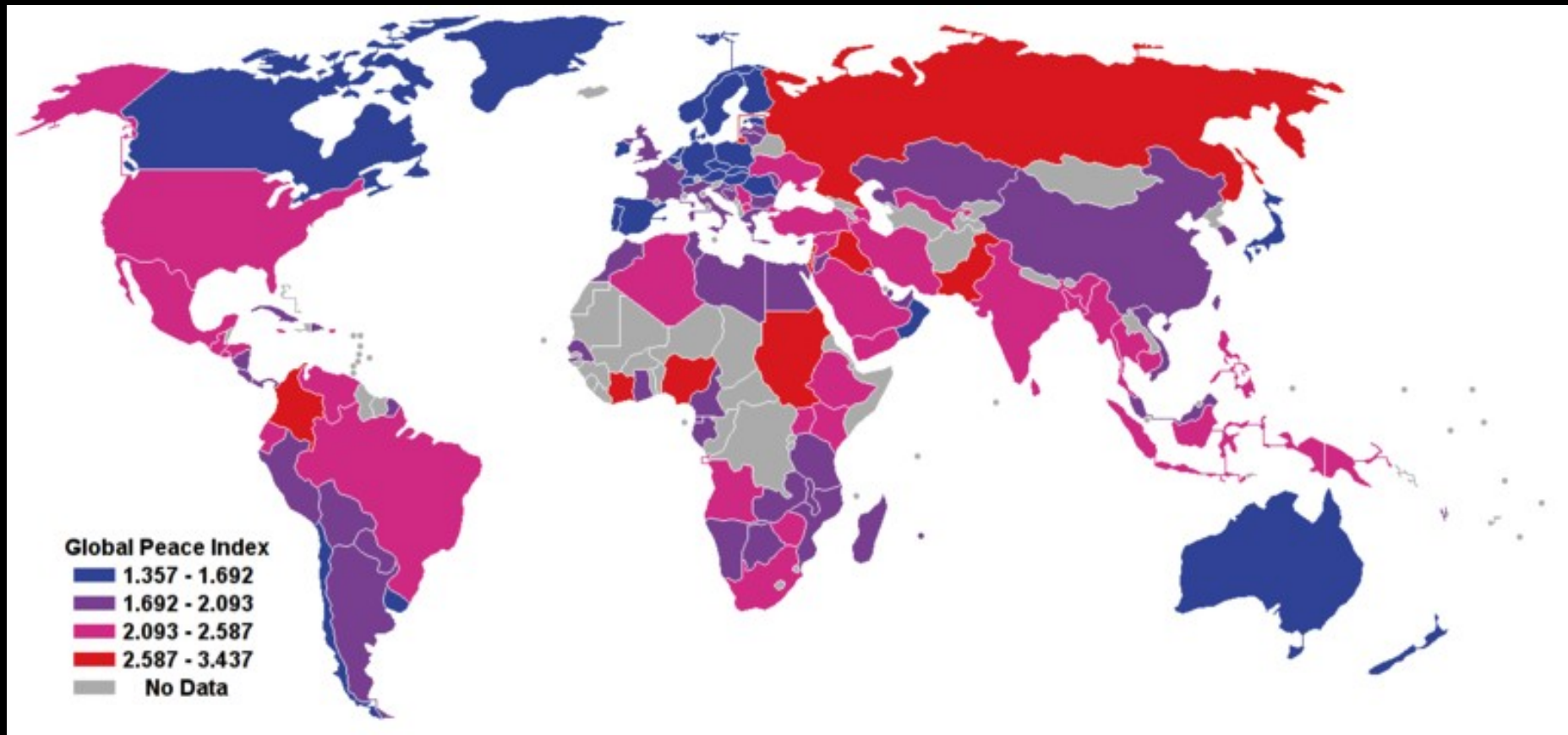
Towards Sustainability: *The Metric ...*

Environmental Performance Index (EPI):



Towards Sustainability: *The Metric ...*

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



Towards Sustainability: *The 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”.

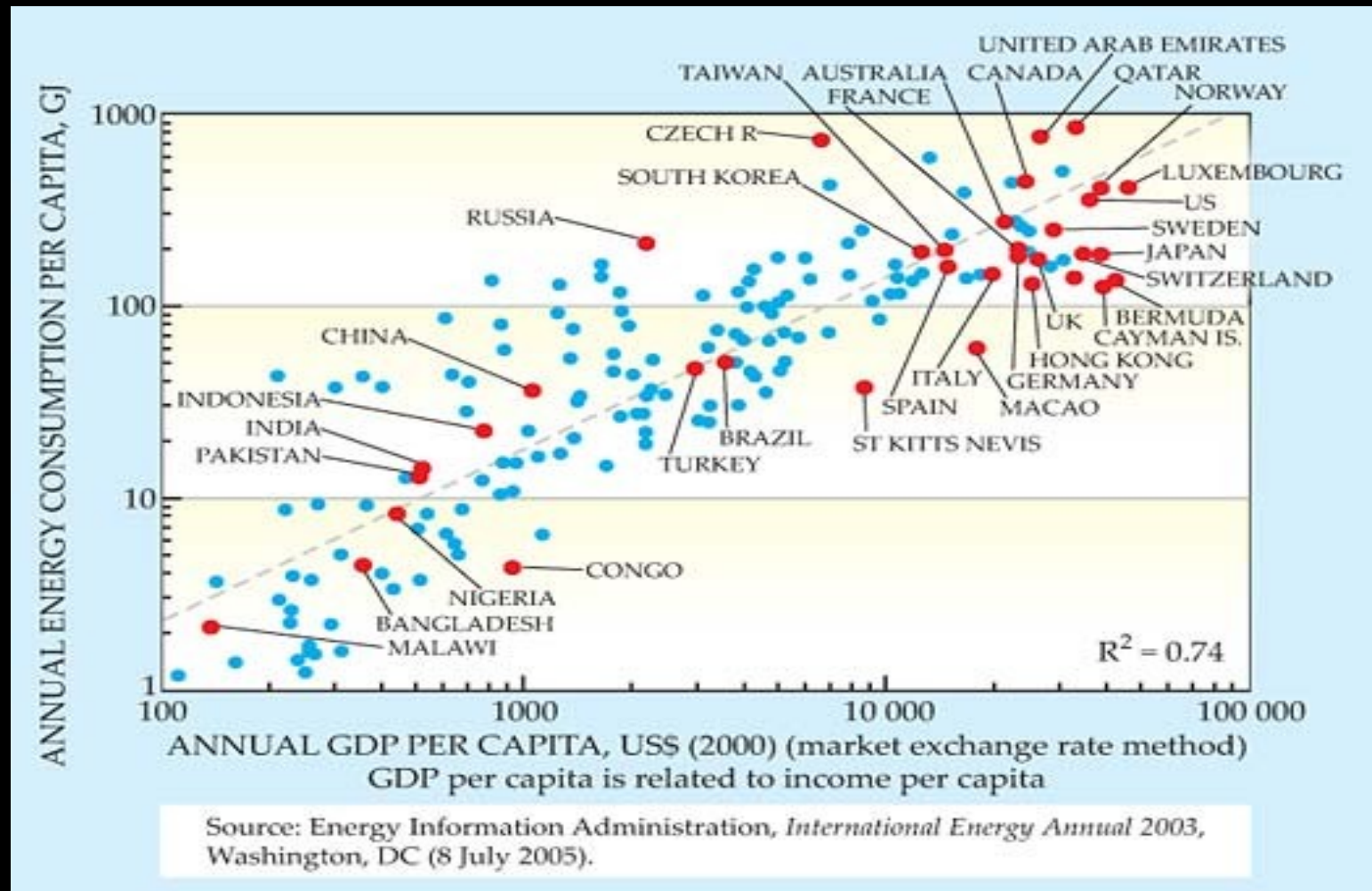
Towards Sustainability: *The Economic Challenges ...*

Energy:

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

Towards Sustainability: *The Economic Challenges ...*

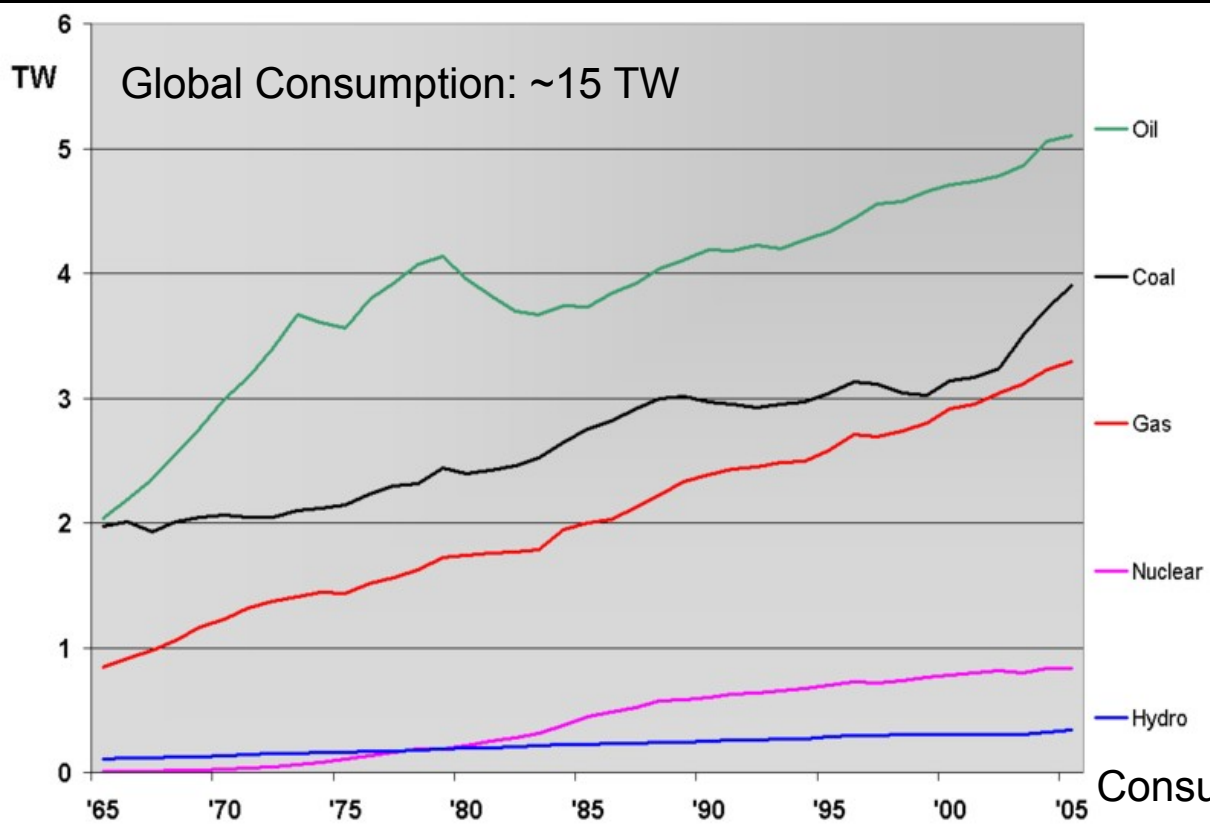
Energy usage and GDP



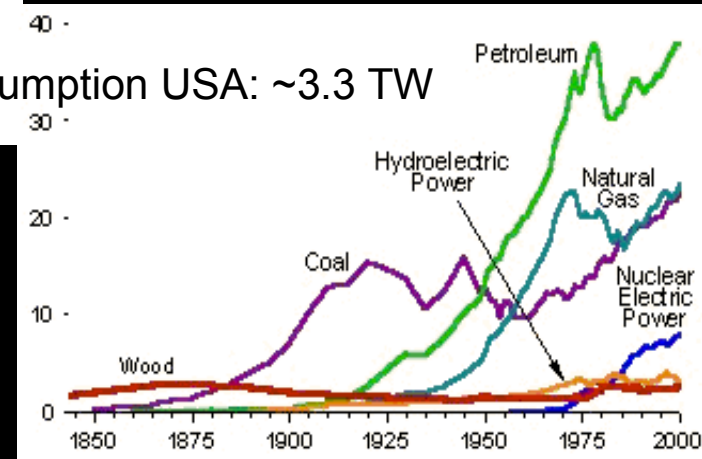
Energy per capita/GDP per capita: ~3 to ~200 MJ/\$

Towards Sustainability: *The Economic Challenges ...*

Energy sources and consumption

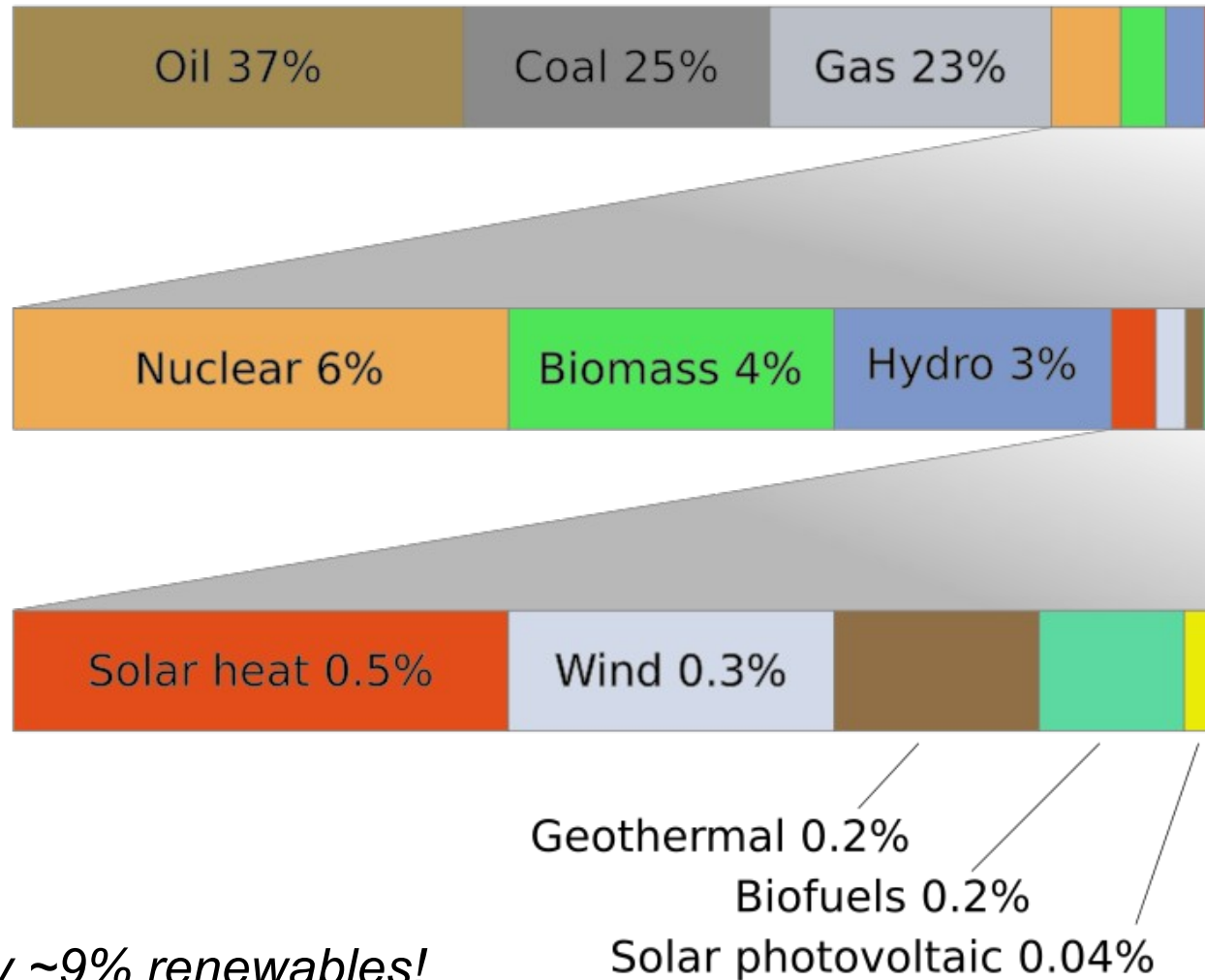


Consumption USA: ~3.3 TW



Towards Sustainability: *The Economic Challenges ...*

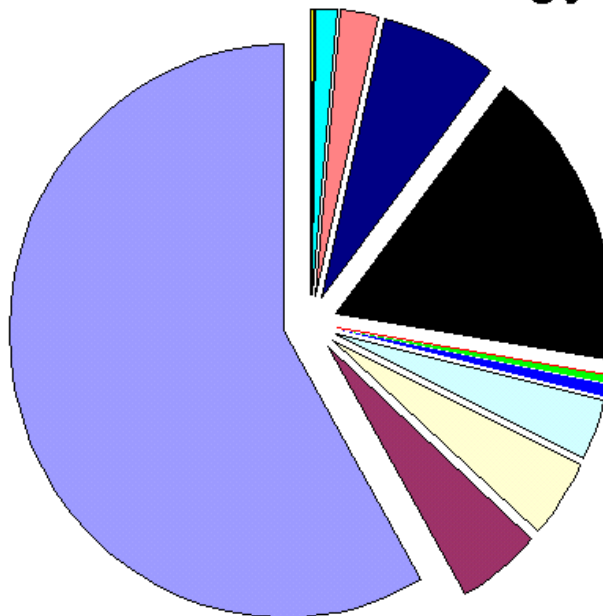
The Global Energy Mix















Towards Sustainability: *The Economic Challenges ...*

The Global Energy Mix: Renewables

World Renewable Energy 2005



 Large hydro 58.23%	 Small hydro 5.12%	 Wind power 4.58%	 Biomass elec 3.42%
 Geothermal elec 0.72%	 Photovoltaic 0.42%	 Other elec** 0.05%	 Biomass heat* 17.08%
 Solar heat 6.83%	 Geothermal heat 2.17%	 Biodiesel fuel 1.21%	 Bioethanol fuel 0.16%

Towards Sustainability: *The Economic Challenges ...*

Energy: Steps in the right direction?

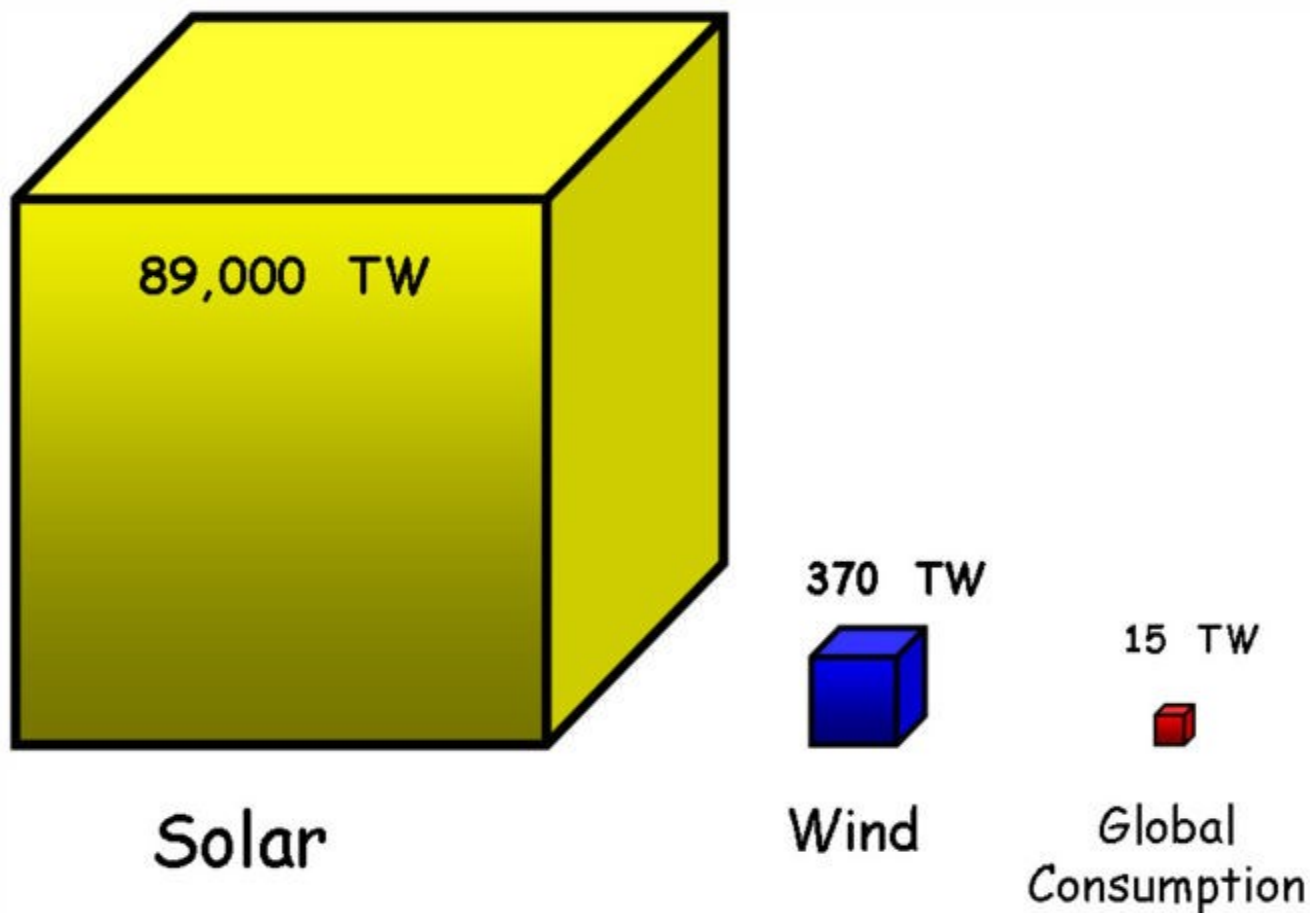
Biofuels



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



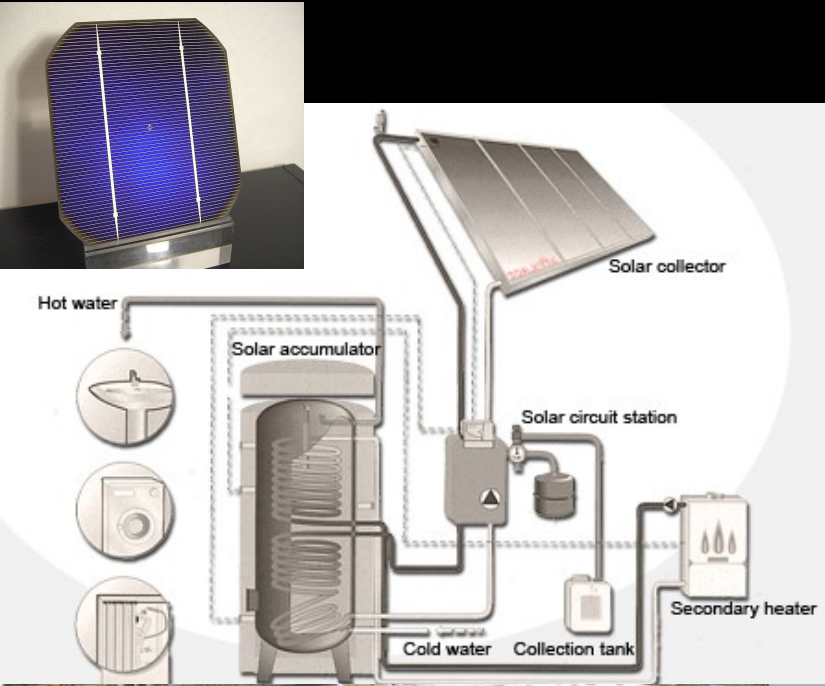
World Wind Energy - Total Installed Capacity (MW) and Prediction 1997-2010



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



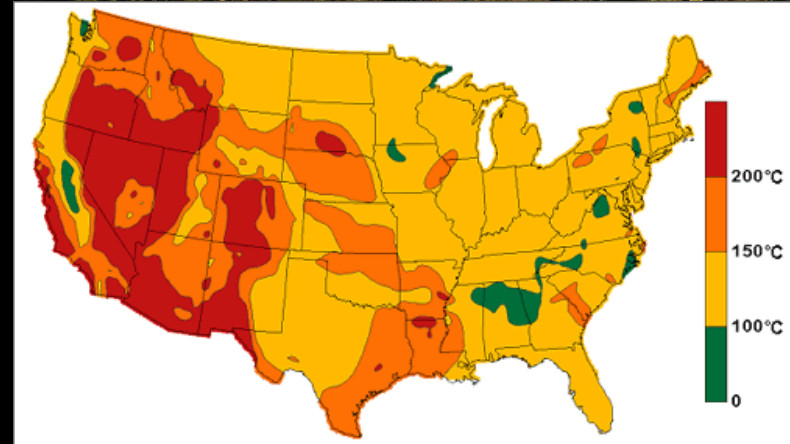
“Three test flights of the two-seater aircraft took place in February and March at an airfield at Ocana, south of Madrid.” *BBC, April 4, 2008.*

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: *What can you do now?*



Towards Sustainability: *What can you do now?*

Some examples in your personal 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.