

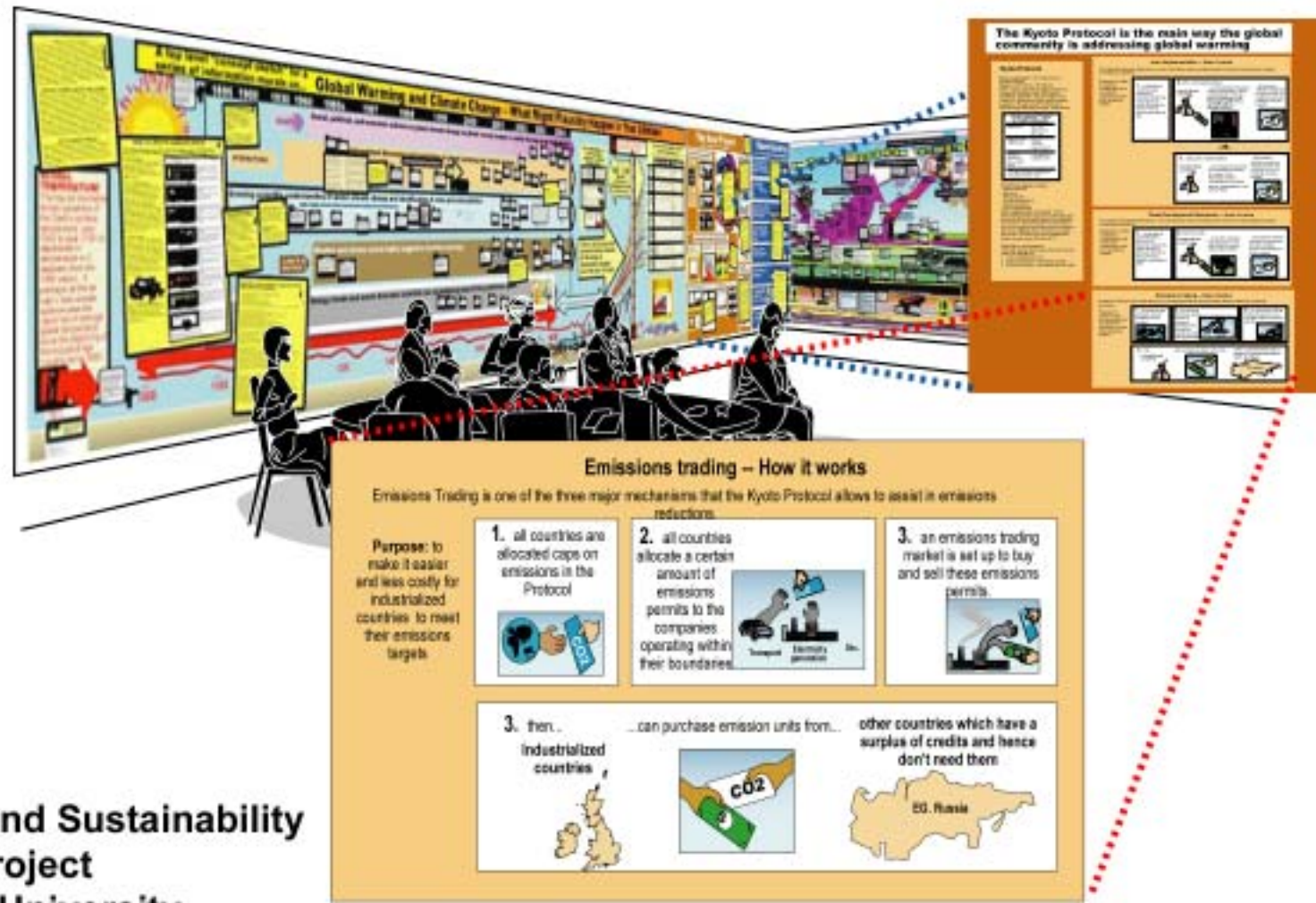
Climate and Sustainability Murals Project

**at
Stanford University
and the
World Business Council for Sustainable
Development**

*A Look at Some of Our Wicked Problems in
Global Warming and Sustainability*

**Robert E. Horn
Human Science and Technology
Advanced Research Institute (H-STAR)
Stanford University**

Goal - To create a comprehensive set of info-murals and diagrams for global climate and sustainability issues to aid analysis, learning, and negotiations



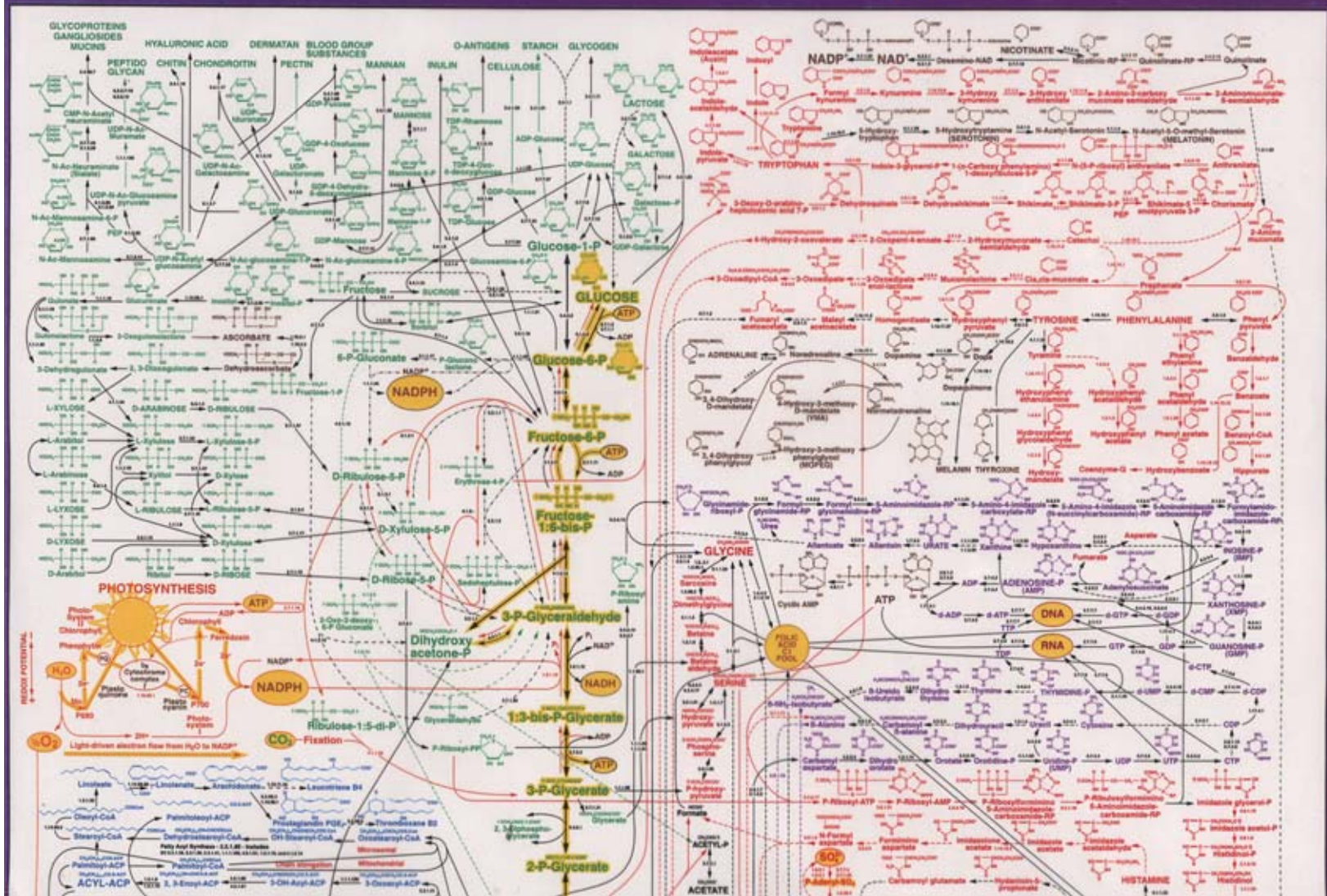
Climate and Sustainability
Murals Project
Stanford University

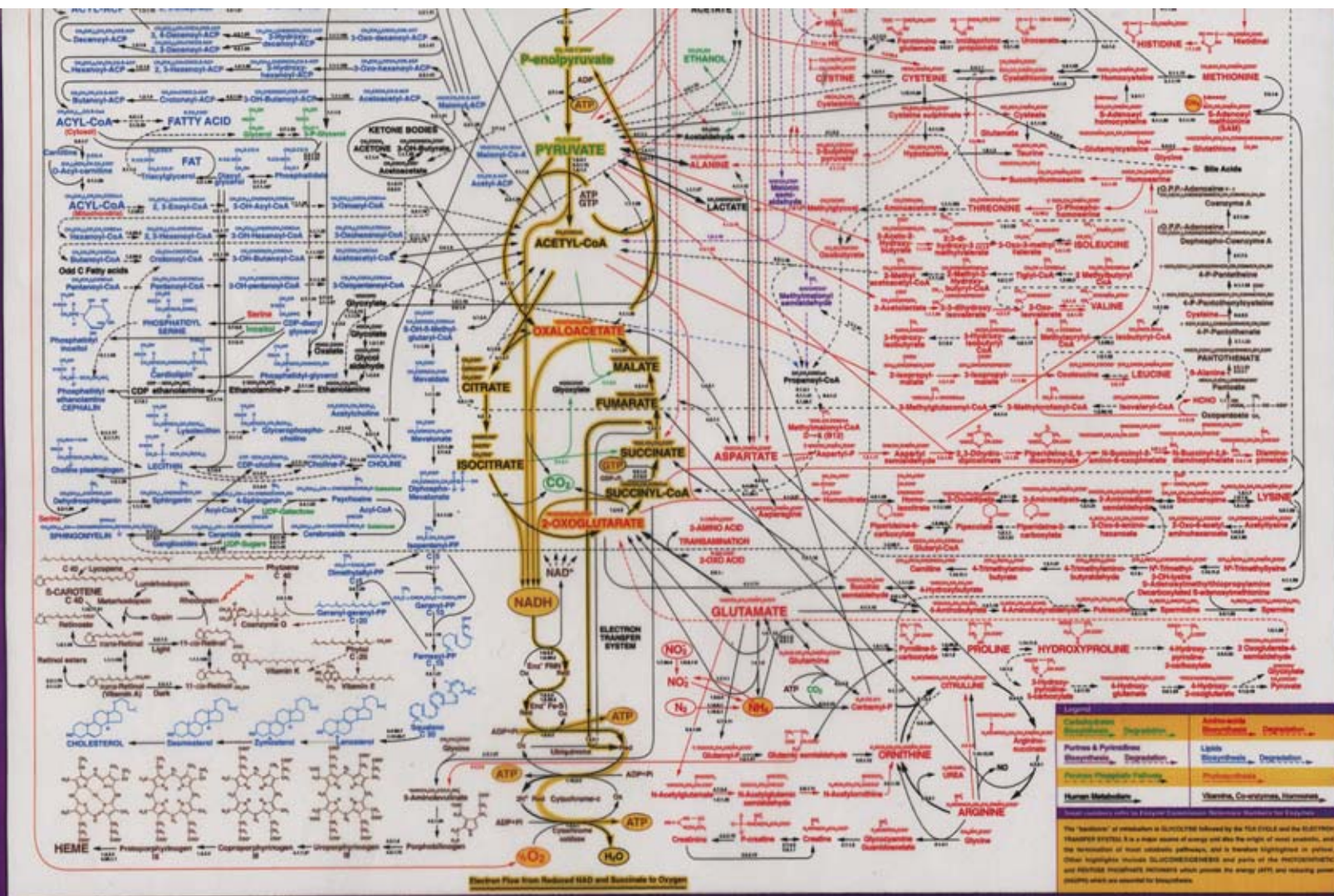
Complexity



Metabolic Pathways

SIGMA
Biochemicals and Reagents
for Life Science Research





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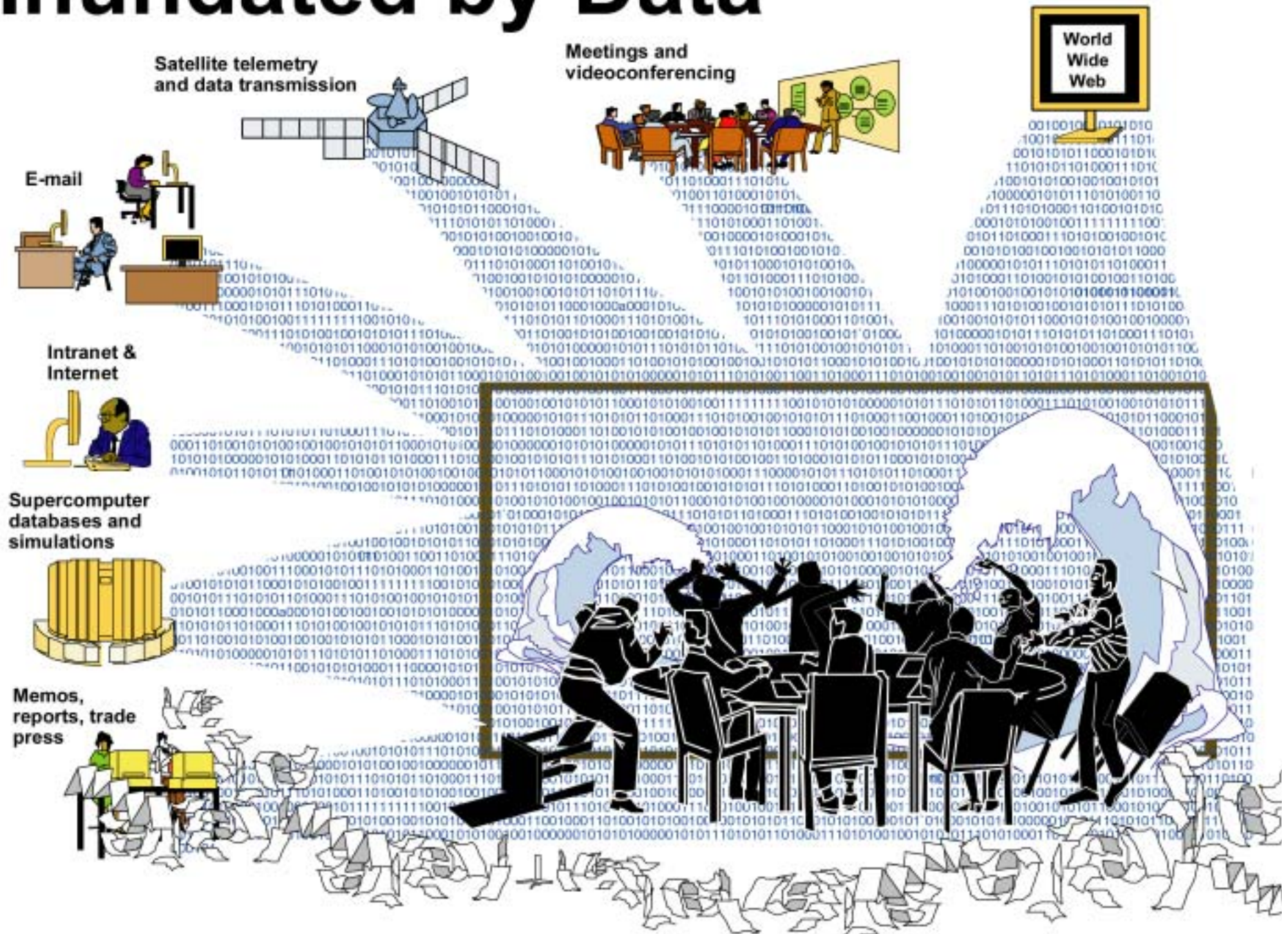
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Inundated by Data



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MONDAY, JUNE 21, 1999

THE WALL STREET JOURNAL R1



A Joint report with
The Wall Street Journal
INTERACTIVE EDITION

Overload

TECHNOLOGY IS DROWNING
THE WORLD WITH INFORMATION.
BUT IT'S ALSO BEGINNING TO
PRODUCE NEW TOOLS TO
MAKE SENSE OF IT ALL.



DEATH
OF THE
OFF-LINE
SALESMAN

16

[illegible]

Social messes

also known as “ill-structured” or “wicked” problems

“We have also come to realize that no problem ever exists in complete isolation. Every problem interacts with other problems and is therefore part of **a set of interrelated problems, a system of problems**. For example, the race problem, the poverty problem, the urban problem, and the crime problem, to mention but a few, are clearly interrelated...English does not contain a suitable word for “system of problems.” Therefore, I have had to coin one. I choose to call such a system a mess.”

Russell Ackoff (1974)

Social messes

also known as “ill-structured” or “wicked” problems

A social mess is a set of
interrelated problems...
and other messes.

Bob Horn

Social Messes

Representing Wicked, Ill-Structured Problems

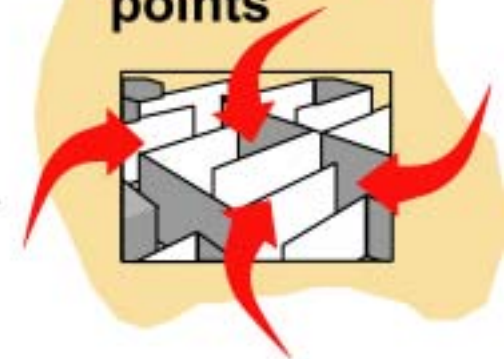
No unique "correct" view of the problem



Ideological constraints



Many possible intervention points



Political constraints



Often a-logical or illogical or multi-valued

$$1+2=7$$
An illustration of a stylized human figure standing next to a large equation, $1+2=7$, which is presented as an example of an illogical or multi-valued statement.

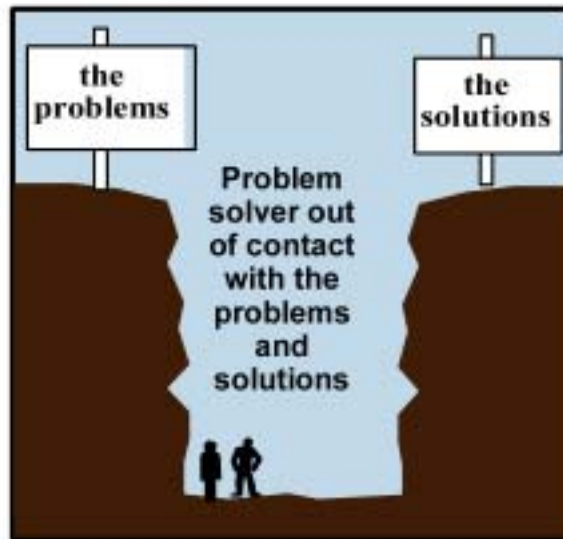
Great Resistance to change



Social Messes-2

Representing Wicked, Ill-Structured Problems

Different views of problem and solutions are contradictory



Most problems are interconnected to other problems



Multiple value conflicts



Risk difficult or impossible to calculate



Considerable Uncertainty

Ambiguous



Consequences difficult to imagine



Data are often uncertain or missing

?	?	?	?	?
?		?	?	?
	?	?		?
?	?	?	?	

**My
Philosophy
of Science
(in brief)**

In my way of thinking...
**all we have to think with are
Mental Models**

definition

men • tal mo • dels

1. "stand for" some thing, event, process,
relationship, etc. (or a bunch of these). **syn.**
thought chunks, concepts, ideas

Note: "Model" is a
metaphor word

which might be a rough
synonym for "concepts"
or "ideas"

so that we can

and by necessity
leave out much

understand
our world

describe
our world

organize
our world

predict
our world

control
our world

feel safe
in our world

**code and
remember**
our world

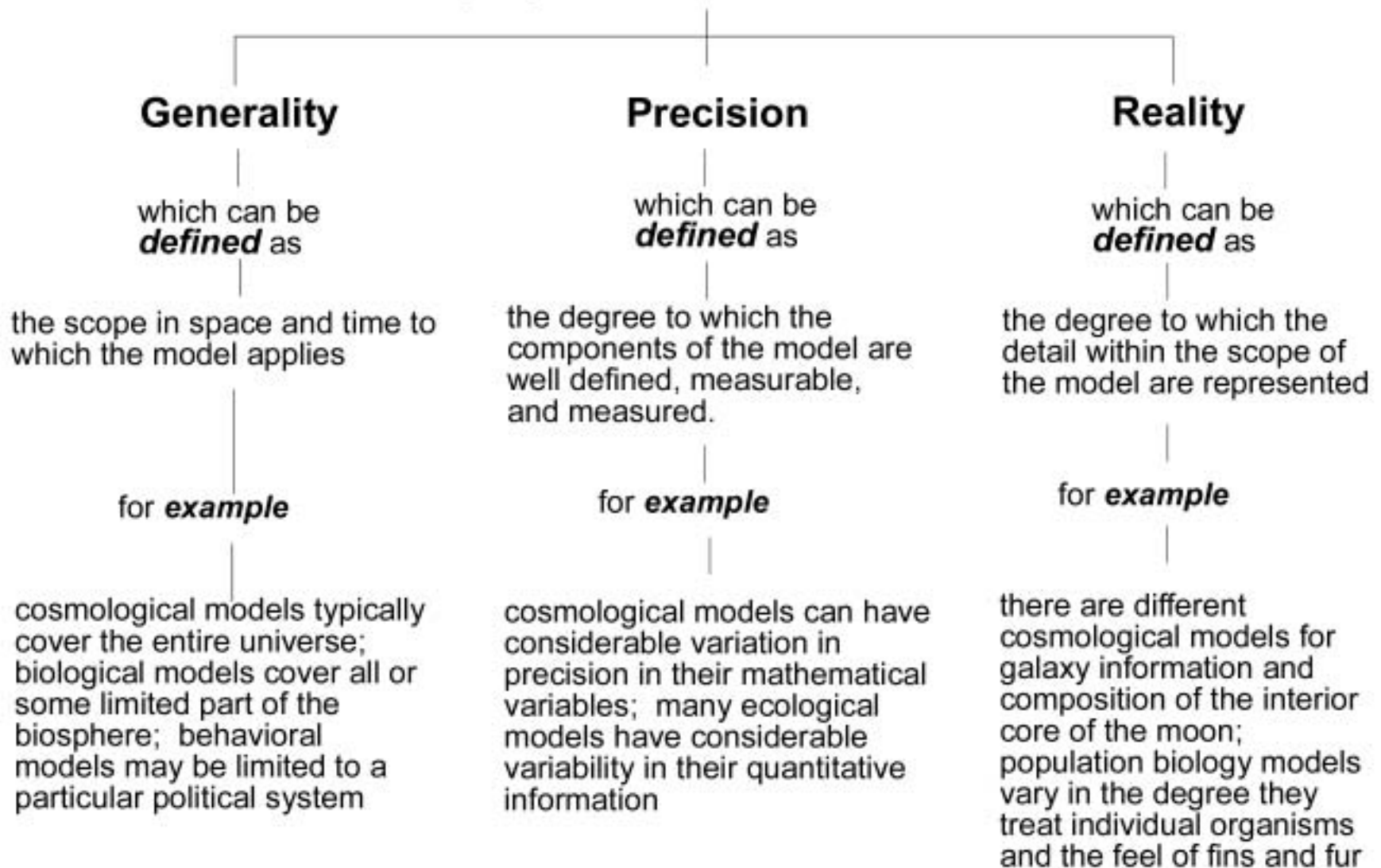
communicate
our world to
others

all models

have these ***properties*** in
varying degrees

Generality **Precision** **Reality**

Generality, precision, and reality – properties of mental models



Model Calibrator

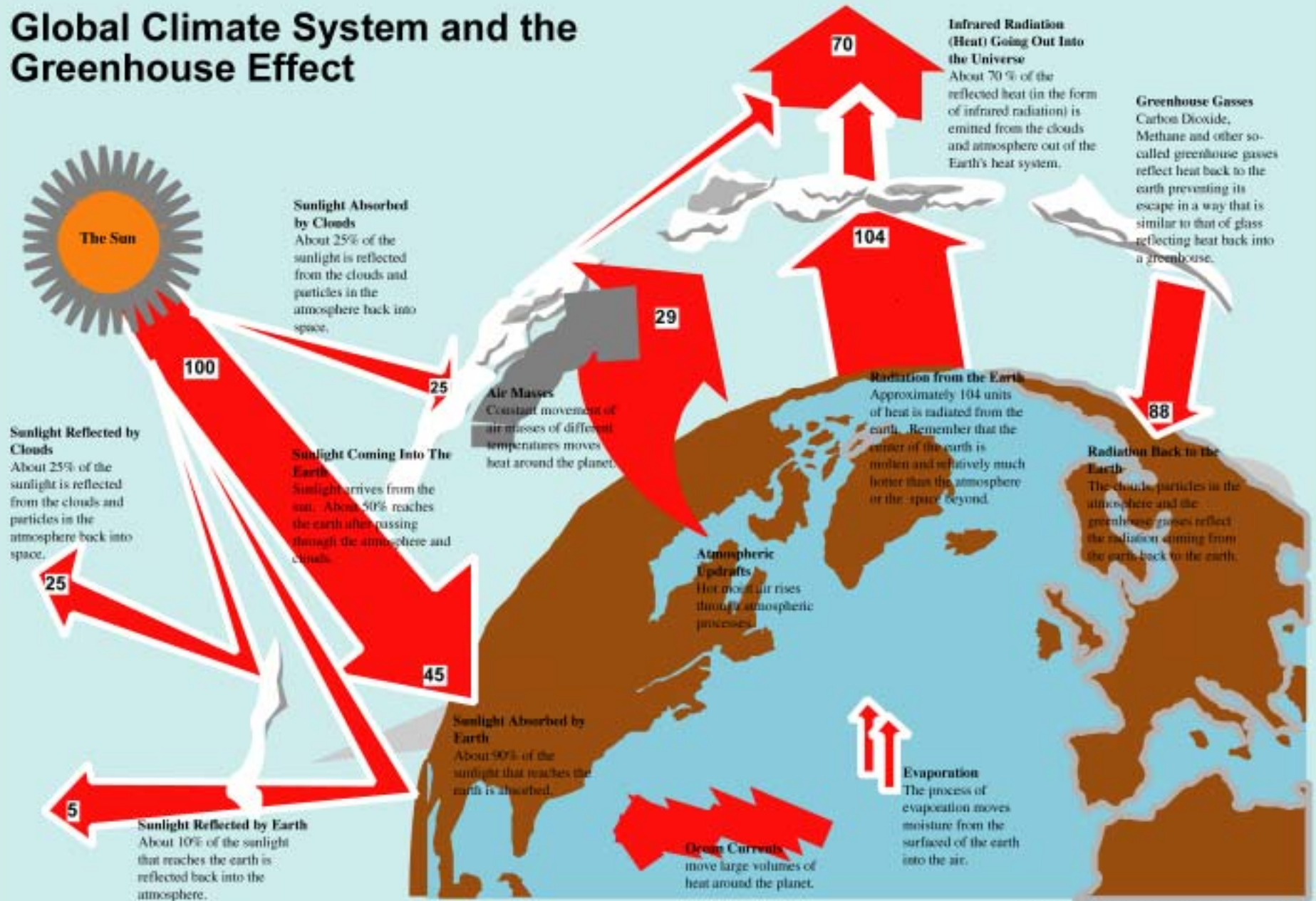
Model Calibrator			
	Low	High	Comments
Generality	<div></div>		Applies to all humans
Reality	<div></div>		Little detailed description
Precision	<div></div>		No metric used

Robert E. Horn



Global Communication
for the 21st Century

Global Climate System and the Greenhouse Effect

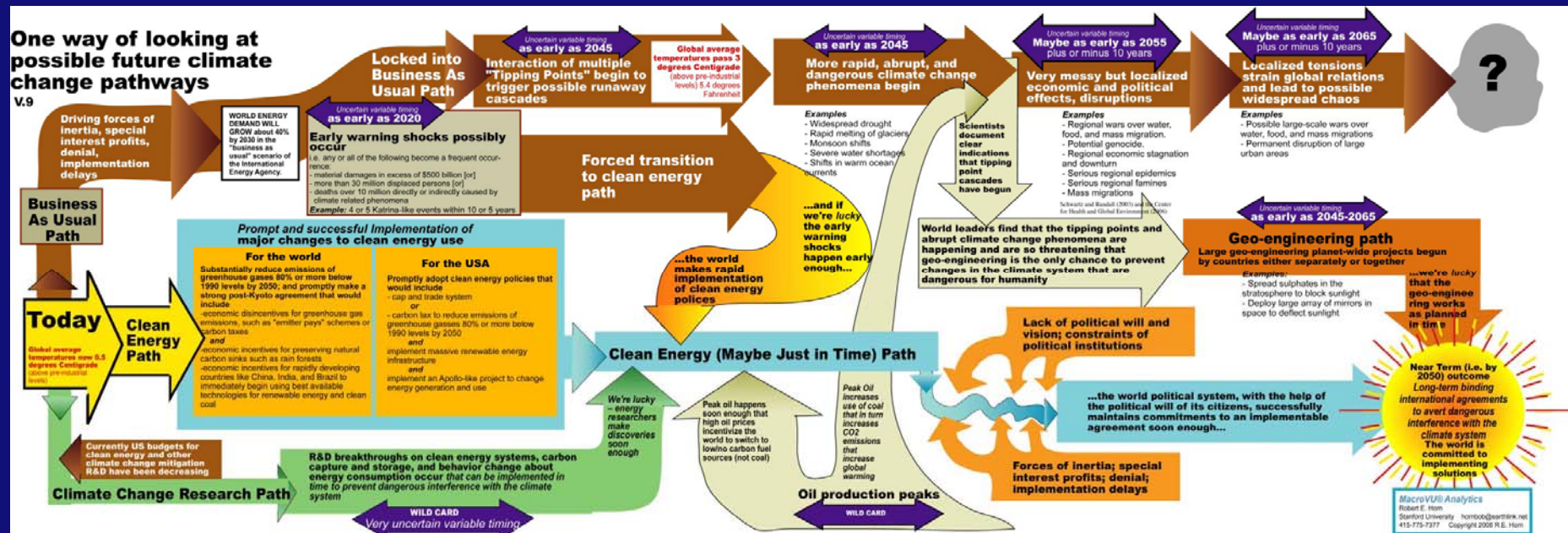


Pathways Map

**The Context
for thinking
about the
next 50**




One way of looking at possible future climate change pathways

v.9



Model Calibrator

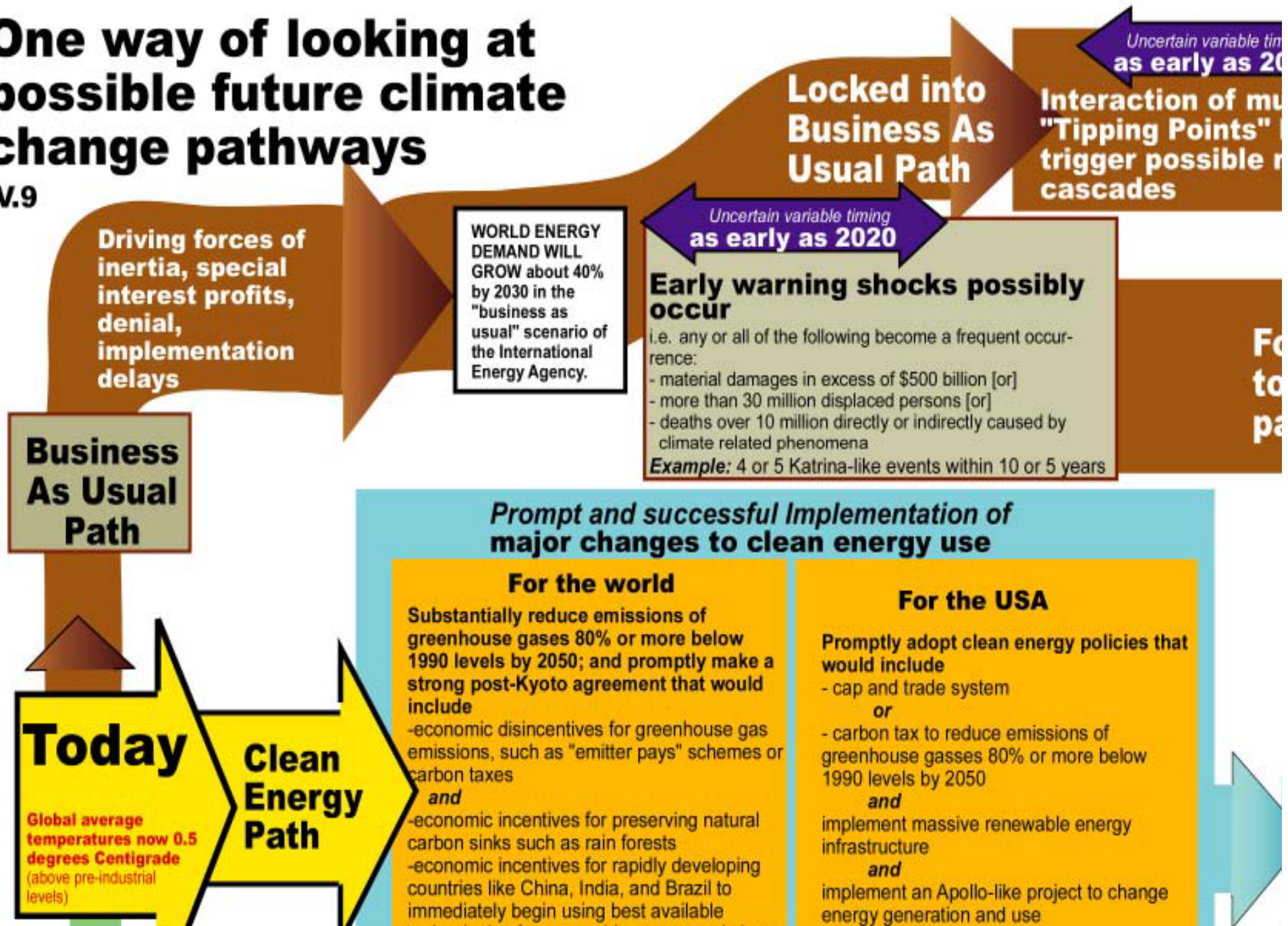
Horn's Climate Pathways Diagram

Model Calibrator			
	Low	High	Comments
Generality			Applies to whole planet. 50 years
Reality			Little detailed description-pretty abstract
Precision			Few, variable metrics

Notes:

One way of looking at possible future climate change pathways

V.9



Fork in the Road - 1

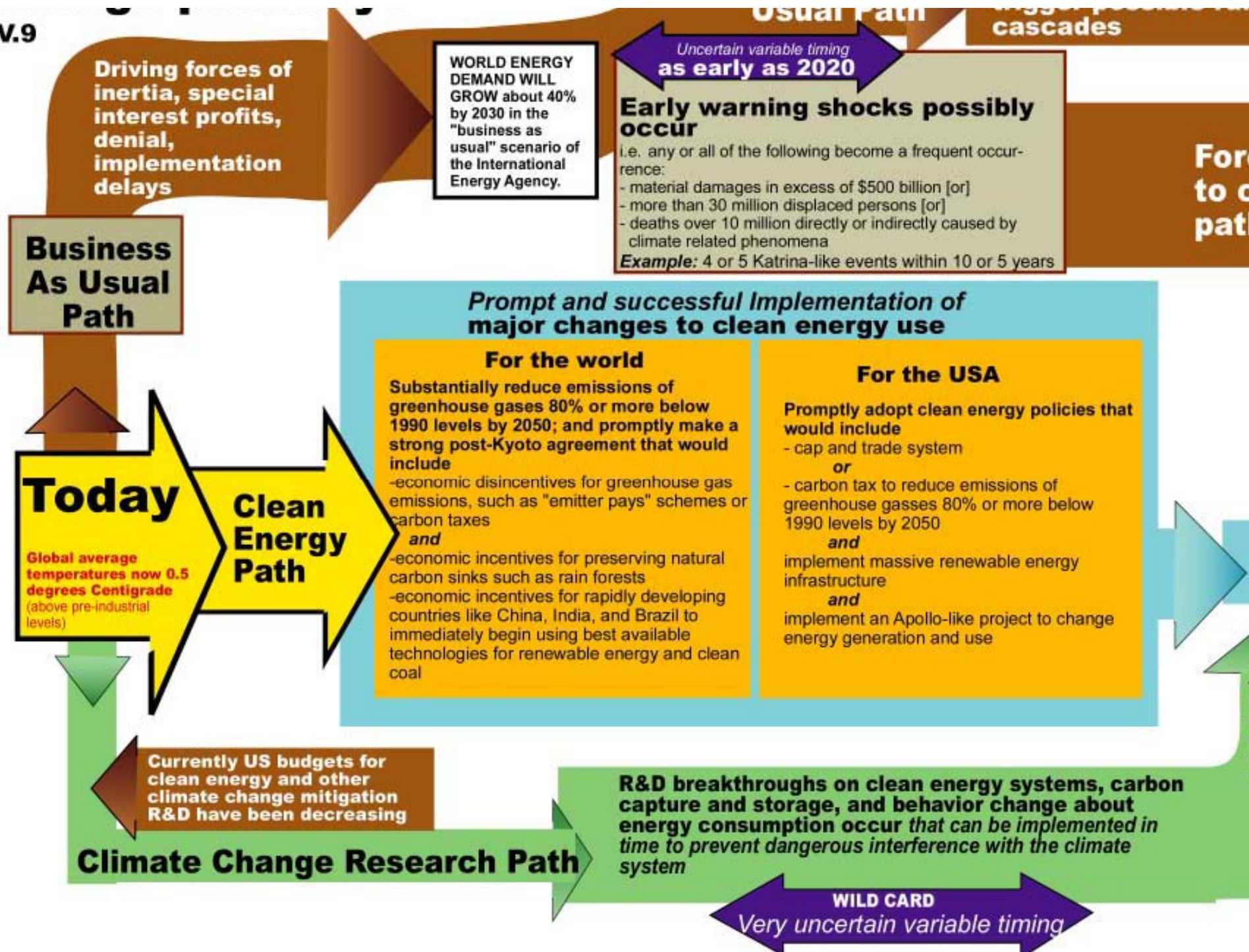
2009-2010



**Clean
Energy**

**Business
as Usual**

**We are on
the
Business as
Usual
Pathway**



Model Calibrator

"We are on the Business as Usual Pathway"

Model Calibrator			
	Low	High	Comments
Generality	<div><div></div></div>		Applies to present
Reality	<div><div></div></div>		Detailed description of energy use available
Precision	<div><div></div></div>		Few Kyoto goals have been met

Notes:

Fork in the Road - 2

Early Warning Shocks



or

**Clean
Energy**

**Business
as Usual**

Uncertain variable timing - Two headed arrow indicates actual time - could be either earlier or later

Era of early warning shocks

What are early warning shocks?

There will likely be one or more early warning shocks (EWS) in the 2010-2025 timeframe (like Hurricane Katrina). When there are sufficient early warning shocks close enough together to produce globally intolerable impact clusters, country leaders and their populations will be frightened enough to act. They will finally really believe what scientists in the IPCC have been predicting.



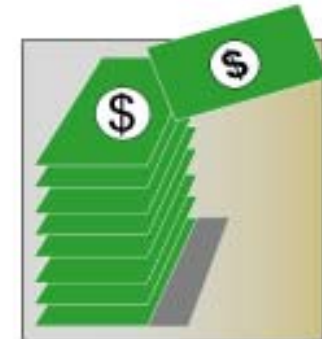
10 million deaths in one year

OR



30 million refugees in one year

OR



\$500 billion damages in one year

Compare with Hurricane Katrina (USA) 2005



1,836 deaths in one storm

OR



200,000 refugees in one event

OR



\$ 84 billion damages in one event

Examples of *plausible* globally intolerable events

between 2020-2050

**Eleven Million Dead as
UN Totals Ravages of
Global Warming**

*Storms and Resource Wars This
Year, Migrations in China, War in
Middle East, and Starvation in
Africa Blamed*

between 2020-2050

**\$500 Billion Bill
Insurance Industry
Staggers Under Global
Warming Damages**

*Losses are Greater Than
Predicted in the Early Part of
the Century*

between 2020-2050

**Waves of Refugees
Attempting to Enter
Every Border of Europe,
America, and Other
Countries are Met with
Violent Anti-Immigration**

Key question

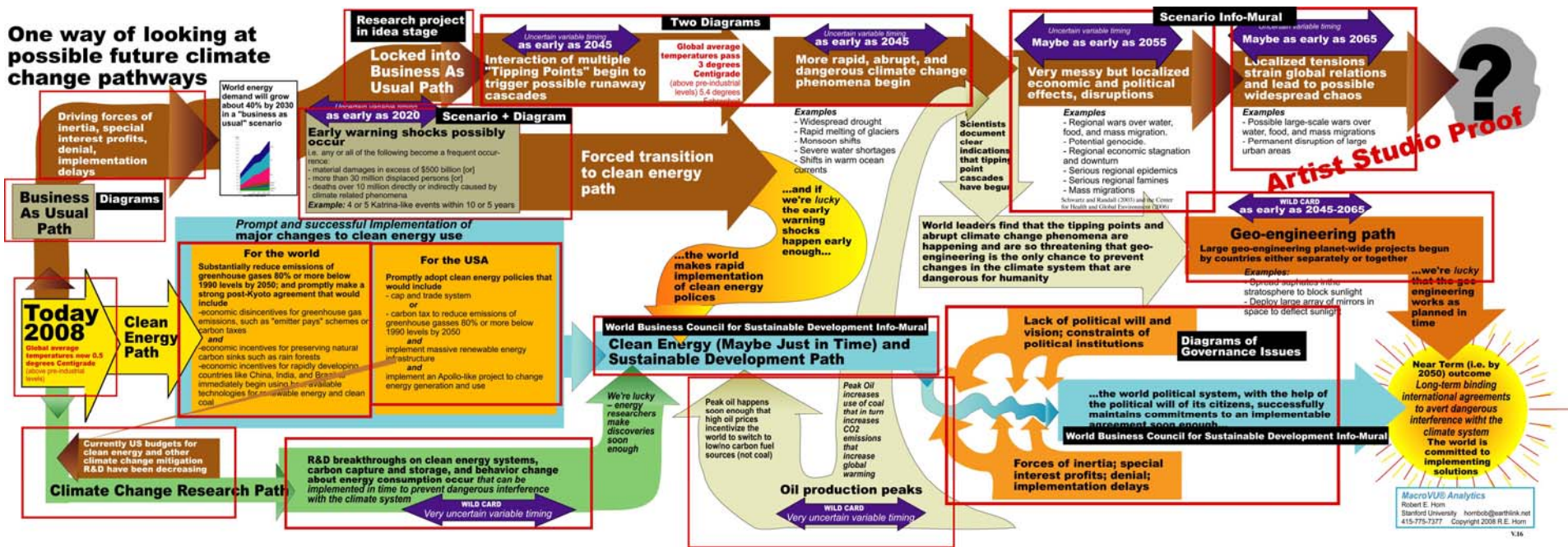
**Will we be
lucky and the
early warning
shocks
happen soon?**

Key question
How close
are we to
being locked
into the
Business as
Usual
Pathway?

Key question

**When is it too
late to get off
the
Business as
Usual Pathway?**

One way of looking at possible future climate change pathways



Uncertain variable timing
as early as 2045

Interaction of multiple
"Tipping Points" begin to
trigger possible runaway
cascades

Global average
temperatures pass 3
degrees Centigrade
(above pre-industrial
levels) 5.4 degrees
Fahrenheit

Uncertain variable timing
as early as 2045

More rapid, abrupt, and
dangerous climate change
phenomena begin

Examples

- Widespread drought
- Rapid melting of glaciers
- Monsoon shifts
- Severe water shortages
- Shifts in warm ocean currents

Forced transition
to clean energy
path

...and if
we're lucky
the early
warning
shocks
happen early
enough...

...the world
makes rapid
implementation
of clean energy
policies

World leads
abrupt climate
happening
geo-engineering
changes in
dangerous

Clean Energy (Maybe Just in Time) Path

Peak Oil

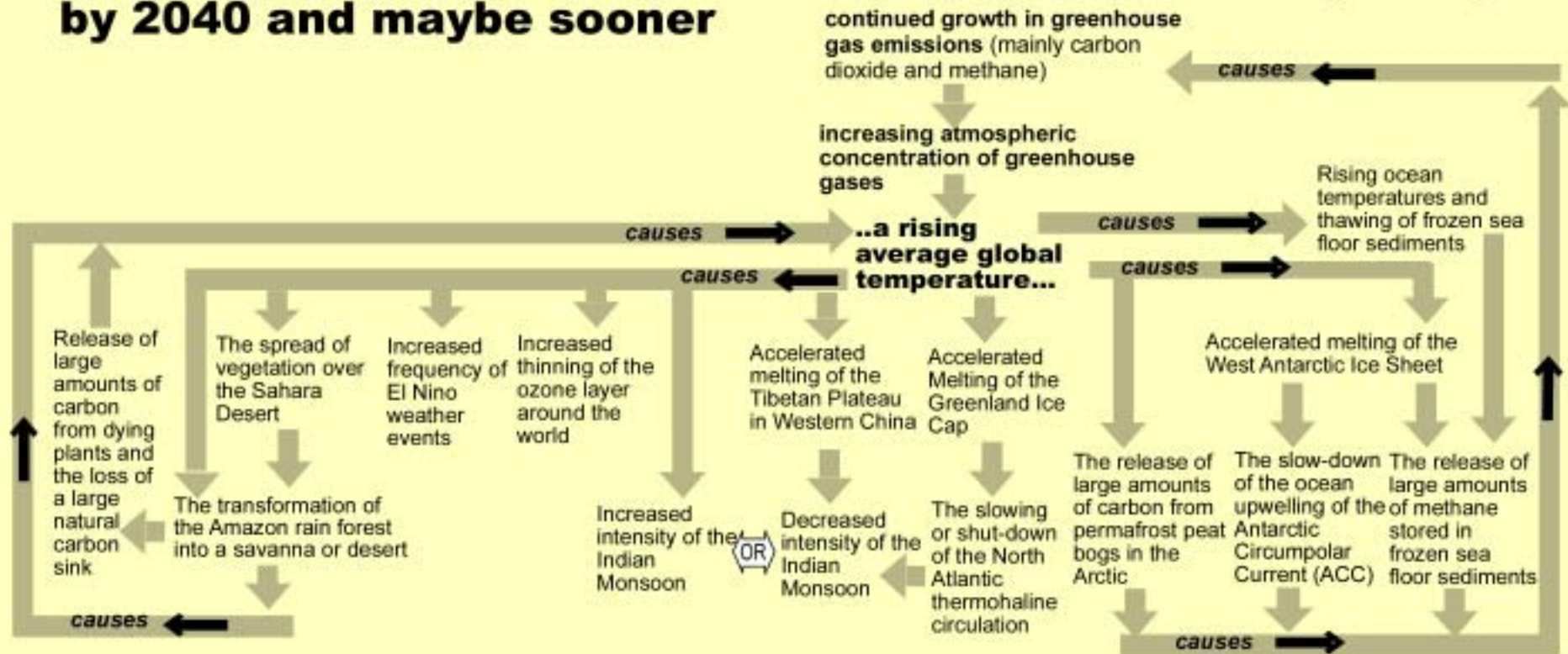
What is a climate tipping point?

Climate tipping points are large, disruptive natural phenomena (usually occurring in a specific region) that could lead to more rapid and abrupt regional and global changes in climate. They are tightly linked by feedback loops that are likely to cause self-reinforcing, accelerating, and potentially irreversible climate changes. Schellnhuber (2004) has identified 11 major natural phenomena he calls possible tipping points. Others name 13 and 14 of them.

What are the tipping points?

- Increased intensity of the Indian Monsoon or Decreased intensity of the Indian Monsoon
- The transformation of the Amazon rain forest into a savanna or desert
- The slowing or shut-down of the North Atlantic thermohaline circulation
- The release of large amounts of carbon from permafrost peat bogs in the Arctic
- The slow-down of the ocean upwelling of the Antarctic Circumpolar Current (ACC)
- The release of large amounts of methane stored in frozen sea floor sediments
- Accelerated melting of the West Antarctic Ice Sheet
- Accelerated Melting of the Greenland Ice Cap
- Accelerated melting of the Tibetan Plateau in Western China
- Increased thinning of the ozone layer around the world
- Increased frequency of El Nino weather events
- The spread of vegetation over the Sahara Desert

Dangerous interference with the climate system risks self-reinforcing feedback from climate tipping points beginning by 2040 and maybe sooner



Possible Climate Tipping Point Cascades v. 2.0

Introduction
This diagram outlines the possible inter-related effects that 11 climate tipping points may have on each other causing them to "cascade." The arrows represent (usually) some theoretical or empirically-based causal influence.

Simplified
This is a simplified diagram that does not represent all of the possible feedback loops in the climate system.

What is a climate tipping point?
Climate tipping points are large, disruptive natural phenomena (usually occurring in a specific region) that could lead to more rapid and abrupt regional and global changes in climate. They are tightly linked by feedback loops that are likely to cause self-reinforcing, accelerating, and potentially irreversible climate changes. Schellnhuber (2004) has identified 11 major natural phenomena he calls possible tipping points.

Example
As the concentration of CO₂ in the atmosphere increases, the average global temperature has been increasing. Temperature increases in the polar regions will likely accelerate the melting of the huge West Antarctic Ice Sheet (one of the tipping points). This could raise sea levels around the world by up to 5 meters (~16 feet), which in turn could speed the melting of the Greenland Ice Sheet (another of the tipping points).

Both of these tipping points increase sea level, which could melt the eastern Siberian Permafrost (a third tipping point), causing the release of large amounts of methane gas. The methane gas release would significantly increase the greenhouse effect and further increase average global temperatures. This is just one example of how global warming can bring about a cascade of different climate changing events illustrated in this diagram.

Uncertainty. There is a considerable degree of uncertainty in the science of interactions of large climate subsystems (which is one way we can think about climate tipping points). This diagram represents what interactions climate scientists believe could happen, and frequently notes the uncertainty. "Potentially" denotes an event which may occur with a probability greater than zero. "Likely" denotes an event which may occur with a probability greater than 50%.

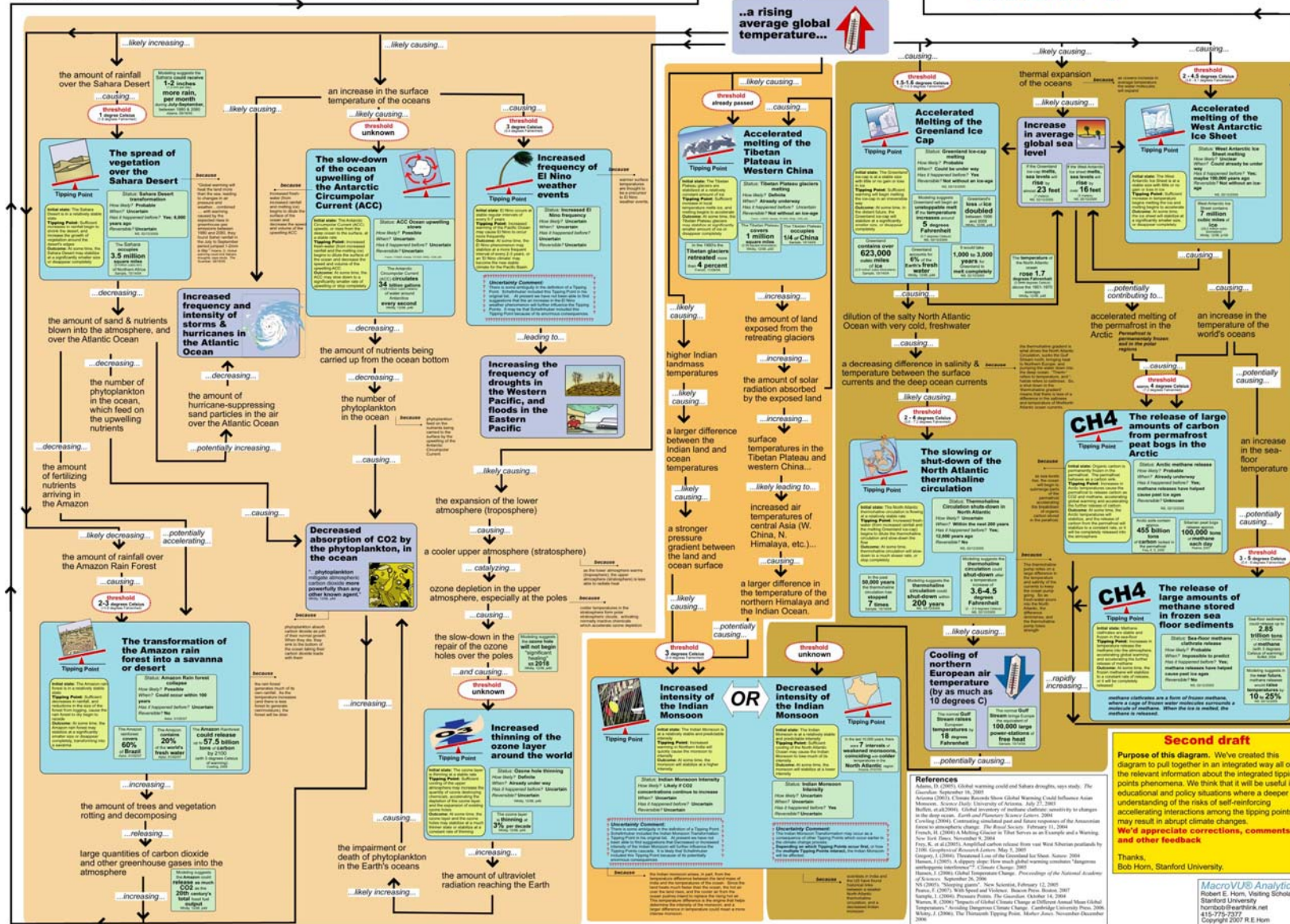
START HERE

continued growth in greenhouse gas emissions (mainly carbon dioxide and methane) ...increases... atmospheric concentration of greenhouse gases

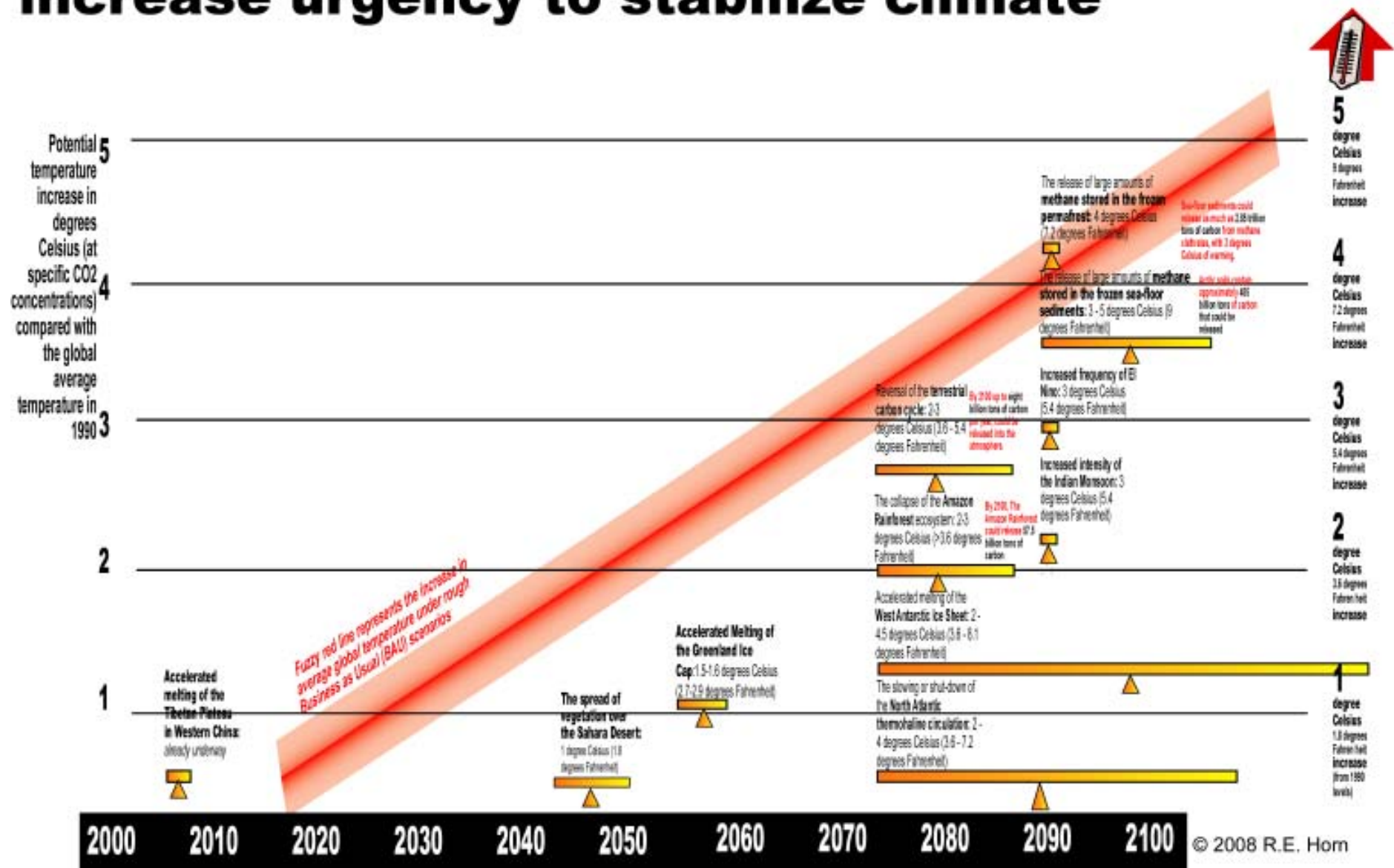
...causes... the atmosphere to retain more heat energy ...measured as... ..a rising average global temperature...

DRAFT

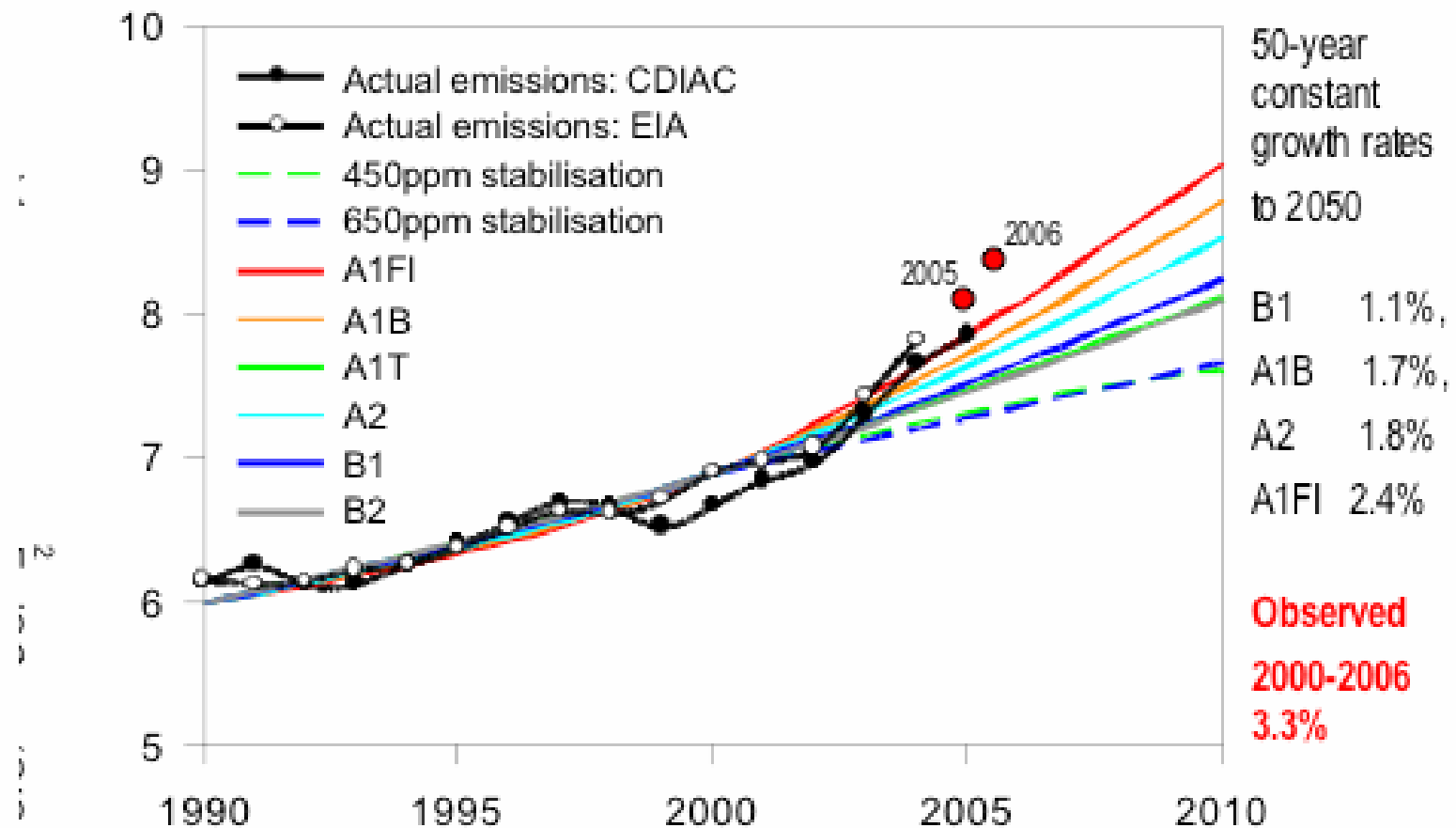
Key
Indicates the specific tipping point phenomena
Major consequence or outcome that results from the changes caused by a tipping point
Indicates the direction of a process in the diagram



Self-reinforcing tipping point interactions increase urgency to stabilize climate



Trajectory of Global Fossil Fuel Emissions



Raupach et al. 2007, PNAS

“ [Holding] climate constant at a given global temperature requires near zero future carbon emissions. . . . As a consequence, any future anthropogenic emissions will commit the climate system to warming that is essentially irreversible on centennial timescales.”

Matthews, H. D., and K. Caldeira (2008), “Stabilizing climate requires near-zero emissions,” *Geophys. Res. Lett.*

“Palaeoclimate data show that the Earth’s climate is remarkably sensitive to global forcings. Positive feedbacks predominate. This allows the entire planet to be whipsawed between climate states. . . . Recent greenhouse gas emissions place the Earth perilously close to dramatic climate change that could run out of our control, with great dangers for humans and other creatures.”

Hansen et al, *Phil. Trans. R. Soc. A* (2007).

Whereas MACHINES

- can be taken apart, analyzed, and fully understood (they are no more than the sum of their parts)
- exhibit “normal” or equilibrium patterns of behavior
- show proportionality of cause and effect, and
- can be managed because their behavior predictable

COMPLEX SYTEMS

- are more than the sum of their parts (they have *emergent* properties)
- can flip from one pattern of behavior to another (they have *multiple equilibriums*)
- show disproportionality of cause and effect (their behavior is often *nonlinear*, because of *feedbacks* and *synergies*), and
- cannot be easily *managed* because their behavior is often *unpredictable*.

In a complex, tightly connected world exhibiting increasingly frequent and severe system shock . . .

the balance of economic and social investment should shift away from efficiency towards resilience.

Key implication

If the tipping points cascade starts happening, then the system flips in a non-linear fashion... and we are in for chaos and catastrophe

Uncertain variable timing
as early as 2045

Interaction of multiple
"Tipping Points" begin to
trigger possible runaway
cascades

Global average
temperatures pass 3
degrees Centigrade
(above pre-industrial
levels) 5.4 degrees
Fahrenheit

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Forced transition
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path

...and if
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...the world
makes rapid
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of clean energy
policies

Clean Energy (Maybe Just in Time) Path

World leads
abrupt climate
happening
geo-engineering
changes in
dangerous

Peak Oil

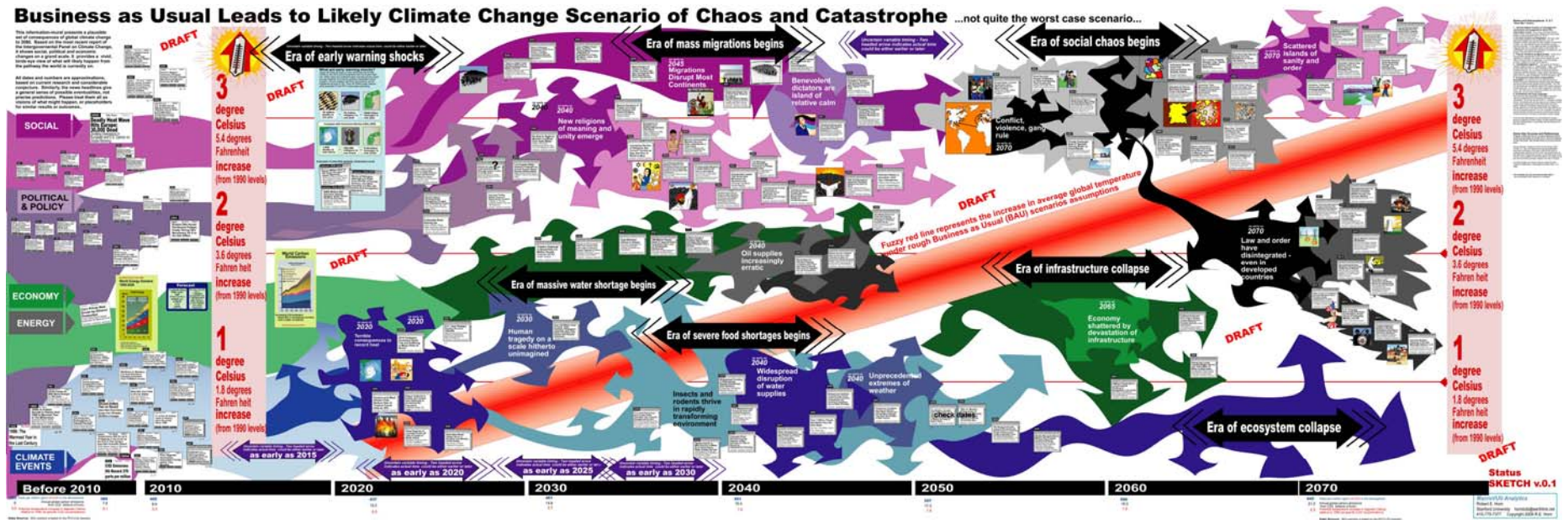
The background of the entire cover is a photograph of a person's arm and hand holding a small, glowing globe of the Earth. The person is wearing a dark, long-sleeved garment. The globe is positioned in the center, with the continents of North and South America visible. The lighting is dramatic, with the globe being the primary light source against a dark, textured background.

M a u r i c e S t r o n g

Where on Earth are We Going?




FOREWORD BY KOFI ANNAN
SECRETARY-GENERAL, UNITED NATIONS

Business as Usual Leads to Likely Climate Change Scenario of Chaos and Catastrophe ...not quite the worst case scenario...



Model Calibrator

Chaos and Catastrophe Scenario

Model Calibrator			
	Low	High	Comments
Generality			Applies to whole planet. 50 years
Reality			Detailed description-Not regionalized
Precision			Few, variable metrics

Notes:

2020

**U.S. Great Plains Area
and Canada Suffer
Twentieth Year of Deadly
Drought and Dry Soil**

World's Most Productive Lands
Turn to Dust, Darken Skies, and
Bury Whole Farms and Towns

**Widespread
disruption
of water
supplies**

2040

**Bukhara and Tashkent
in Central Asia Faced
with Forced Evacuation
of Residents and
Closing of Industries
Due to Water Shortage**

p.12

2035

**Over 100 Million Dead
in China, India,
Pakistan, Bangladesh,
Indonesia, and Other
Asian Countries from
Famine and Disease
Outbreaks**

p.16

2043

**Over 3 Billion People
Worldwide Have No
Safe Water**

*Up from One Billion Just a
Few Years Ago*

p.12

2020

**Plague Outbreak in
Russia and Central
Asia Attributed to
Increasing Rat
Population**

Outbreak Death Toll
Huge

p.15

2023

**Amazon and West
African Fires
Reduce Size of
Tropical Forest
Area by 40%**

p.15

as early as
2020



2020

**Killer Bees Wreak
Deadly Havoc in
Southern and Western
United States**

*New Strain of Bees
Frightens Population*

p.15

**World Business
Council for
Sustainable
Development**

Vision 2050

**My job for the
WBCSD project:**

**Synthesizer
and
Visualizer**

Design Task 1

Analysis and Synthesis Approach

Challenges

Economy

Economy that relies on both labour force growth and improved technological productivity to underpin economic growth; undervalues ecosystem services.

People

Unsustainable population scenarios; poverty and deprivation remain in many parts of the world

Governance

Ineffective governance structures, in particular inability to adequately address global challenges in an increasingly multi-polar world

Energy, Industry & Resources

Depletion of finite resources; growing level of harmful emissions, including GHG emissions

Environment

Degradation of ecosystem services; destruction of habitat and species

The Vision – 2050- 2100

Governance

Inclusive and effective governance at all levels that can adequately address the challenges and enable appropriate solutions

Environment

Manage ecosystems to maintain and enhance services; biodiversity conserved

People

Basic needs of a sustainable world population met

Energy, Industry & Resources

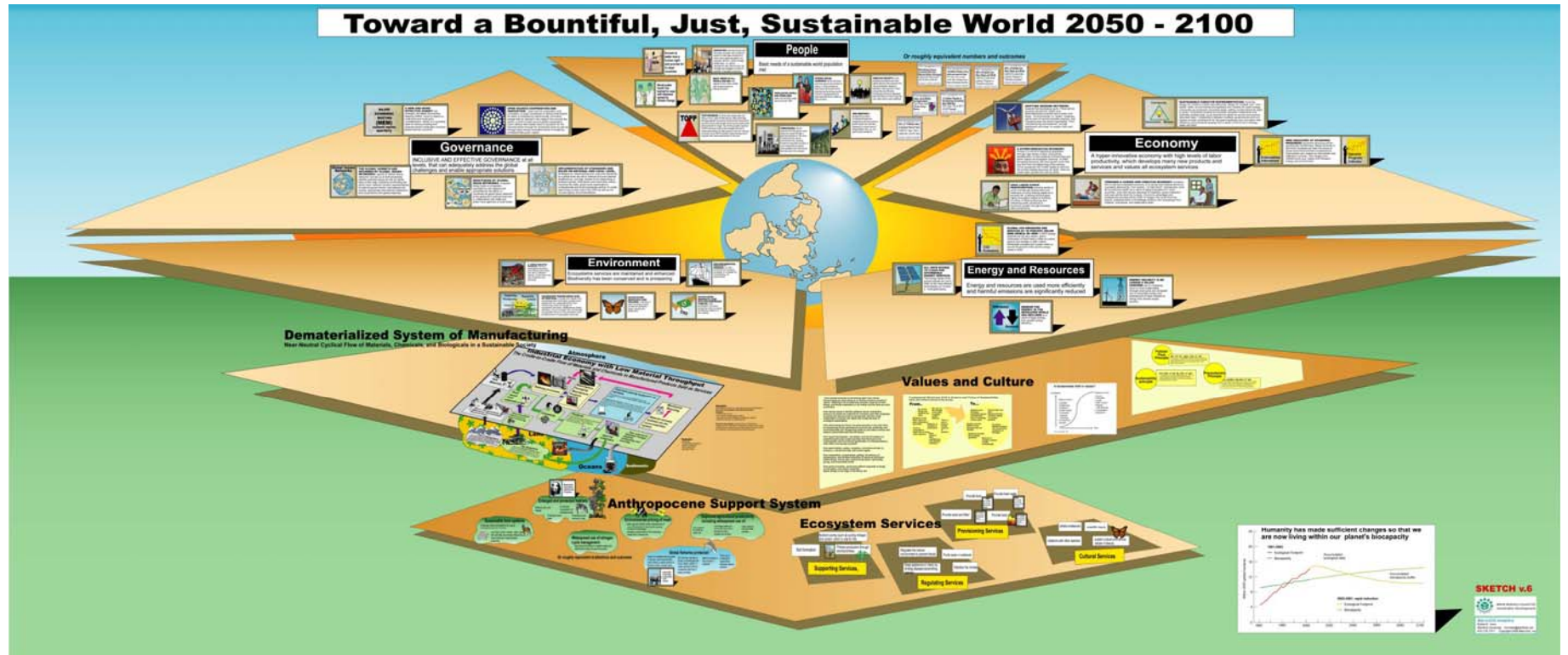
Energy and resources are continuously used more efficiently and harmful emissions are significantly reduced

Economy

A hyper-innovative economy that thrives in a world of stabilising population through high levels of labour productivity and development of new products and services; values all ecosystem services

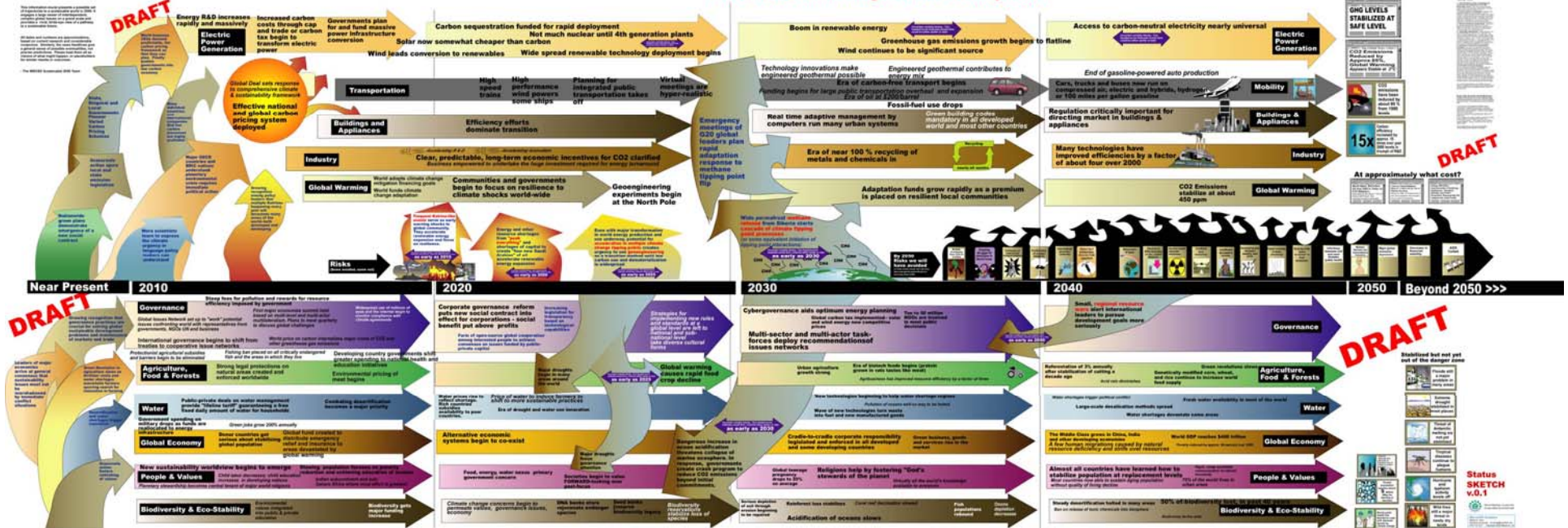


Toward a Bountiful, Just, Sustainable World 2050 - 2100



How does the world achieve the WBCSD's Vision 2050?

Version 0.3 summary sketch straw person



Major OECD countries and BRIC nations understand planetary environmental crisis requires immediate political action

Grassroots action spurs local and state emission legislation

Nationwide green plans demonstrate emergence of a new social contract

More scientists learn to express the climate urgency in language policy makers can understand

Many individual countries and international companies find low carbon processes are highly profitable

State, Regional and Local Governments Pioneer Varied Carbon Pricing Schemes

Growing recognition among policy leaders that multiple Katrinas happening every year will devastate many areas of the world--both

World business CEOs demand predictable, fair carbon pricing framework so that they can plan. Finally pushes governments into low carbon economy

Leaders of major economies arrive at general consensus that sustainability issues must not be overshadowed by immediate conflict situations

Growing recognition that governance practices are crucial for solving global sustainable development problems and maintenance of markets and trade

Revolution in agriculture slows as fertilizer costs and water shortages overwhelm farmers spurring search for innovation in farming

Desertification and water shortages trigger innovation

Grassroots action fosters rethinking of values

Backcasting approach

- start with our Vision 2050**
- ask "for the Vision to be accomplished in 2050, what has to happen in**
 - 2040**
 - 2030**
 - 2020**
 - 2010****(in each of the sectors, e.g. energy, food, water, etc.)"**
- determine the linkages between sectors**

What energy changes have been accomplished in the last 45 years?

Renewable Energy Sources Built Over the Past Four Decades

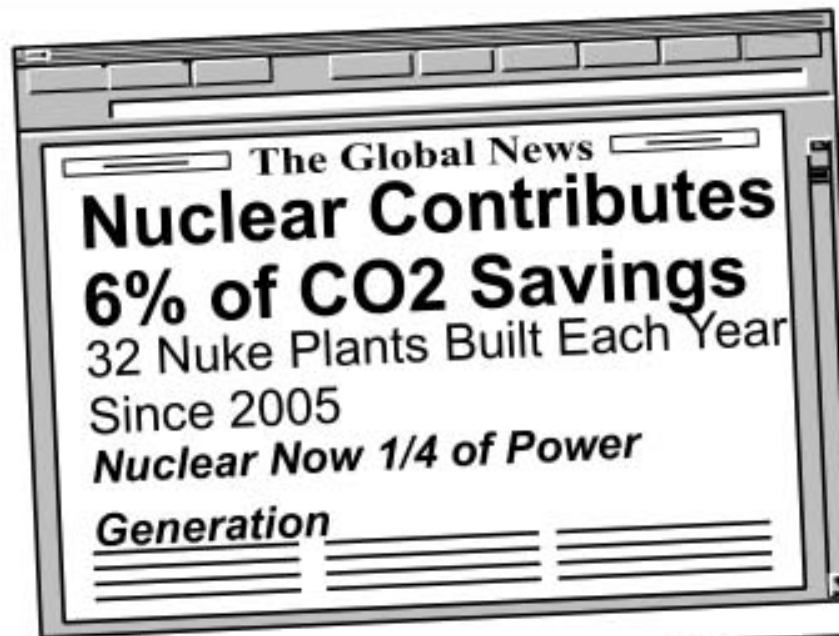
	Number built each decade				Total by 2050	Units
	2020	2030	2040	2050		
Nuclear	+60*	+200	+1,820	+0	2,080	1000 mw nuclear plants
Biomass	+100	+1,000	+1,000	+1,900	4,000	50 mw biomass plants
Onshore Wind	+5,000	+11,000	+15,000	+25,000	56,000	4 mw wind turbines
Offshore Wind	+15,000	+25,000	+45,000	+65,000	150,000	4 mw wind turbines
Geothermal	+0	+0	+2,000	+50,000	52,000	100 mw geothermal units
Solar PV	+150	+4,000	+2,225	+2,225	8,600	million meters squared solar panels
Solar CSP	+200	+800	+900	+1,300	3,200	250 mw CSP plants
Coal-fired CCS	+0	+120	+580	+700	1,400	500 mw CSS plants

Renewable Energy Projections Based on IEA BLUE Scenarios

Source: IEA BLUE Scenario 2010-2050

Or some roughly equivalent mix

In the 2040s



In the 2030s

2040

Wind Becomes Major Source of World Energy Production
as Global Industry Installs at Least 140,000 More Turbines in Decade Since 2030

Nuclear Industry Continues to Build
Accelerate New Plants, to Meet Sustainable 2050 Goal of 900 New Plants

2040

Landmark 6,500 Square Miles of Solar Photovoltaic Cells!

Milestone Inspires World Celebrations, as IEA Report Growth Between 2010-2040

2040

2050

Magnifying the Sun
3,200 New CSP Plants
Since 2010, each 250-megawatt-- Provides 20 new gigawatts annually

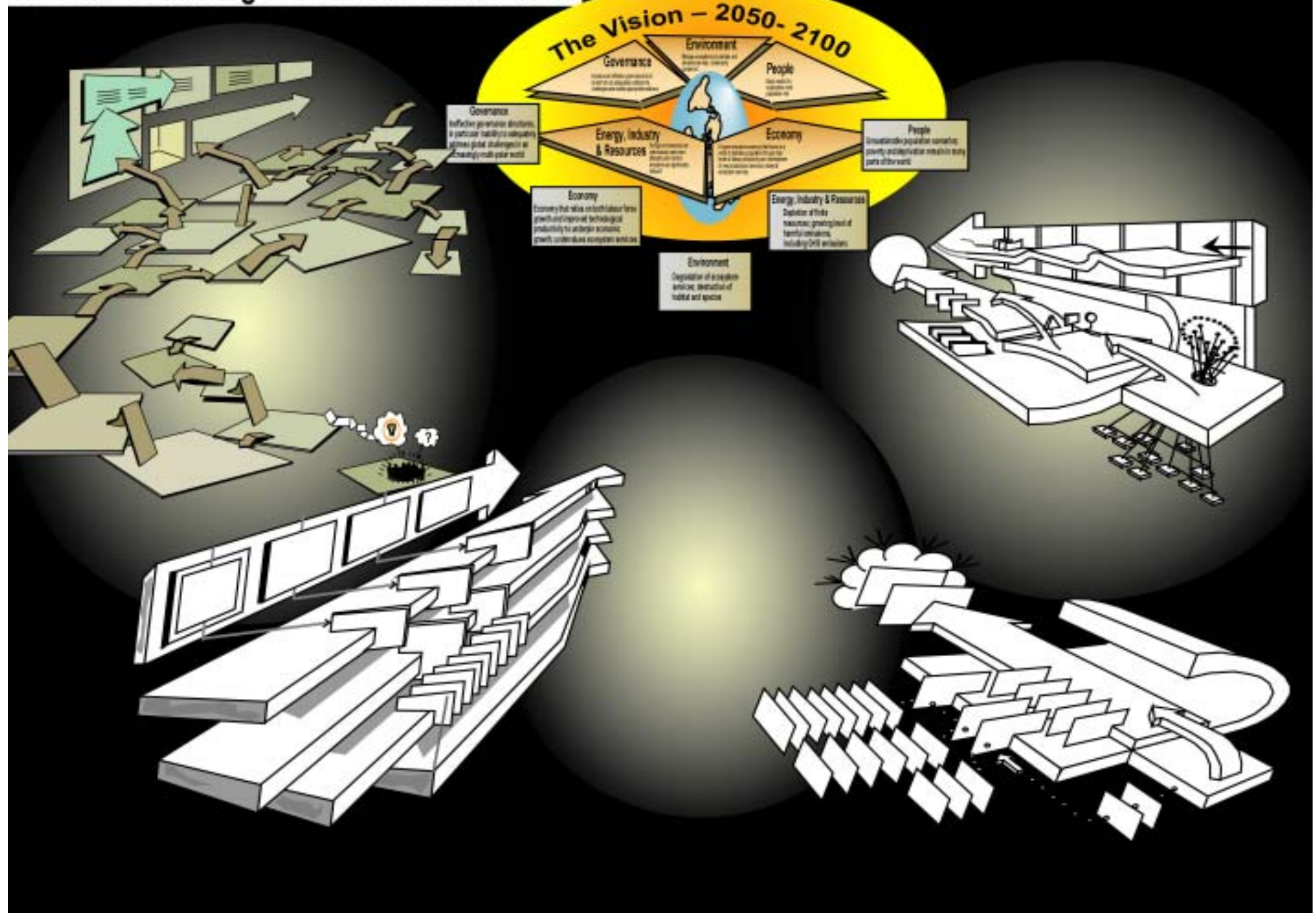
Sequestration of Carbon from Coal Powered Plants
Now Global Standard as the Industry Meets Need for 350 New Clean Plant This Decade

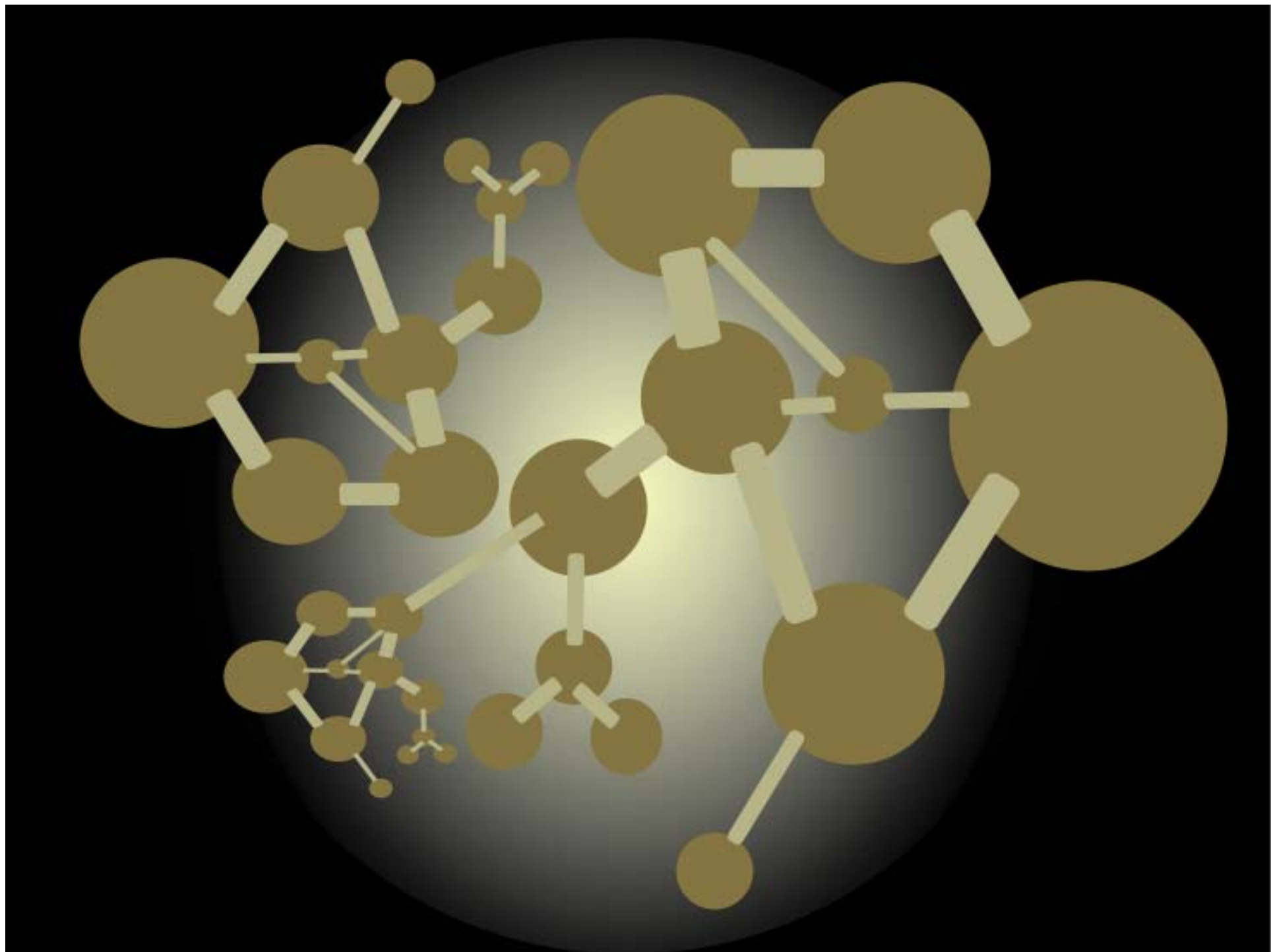
2039

Design Task 2

Large Structure of Panoramic Information Mural

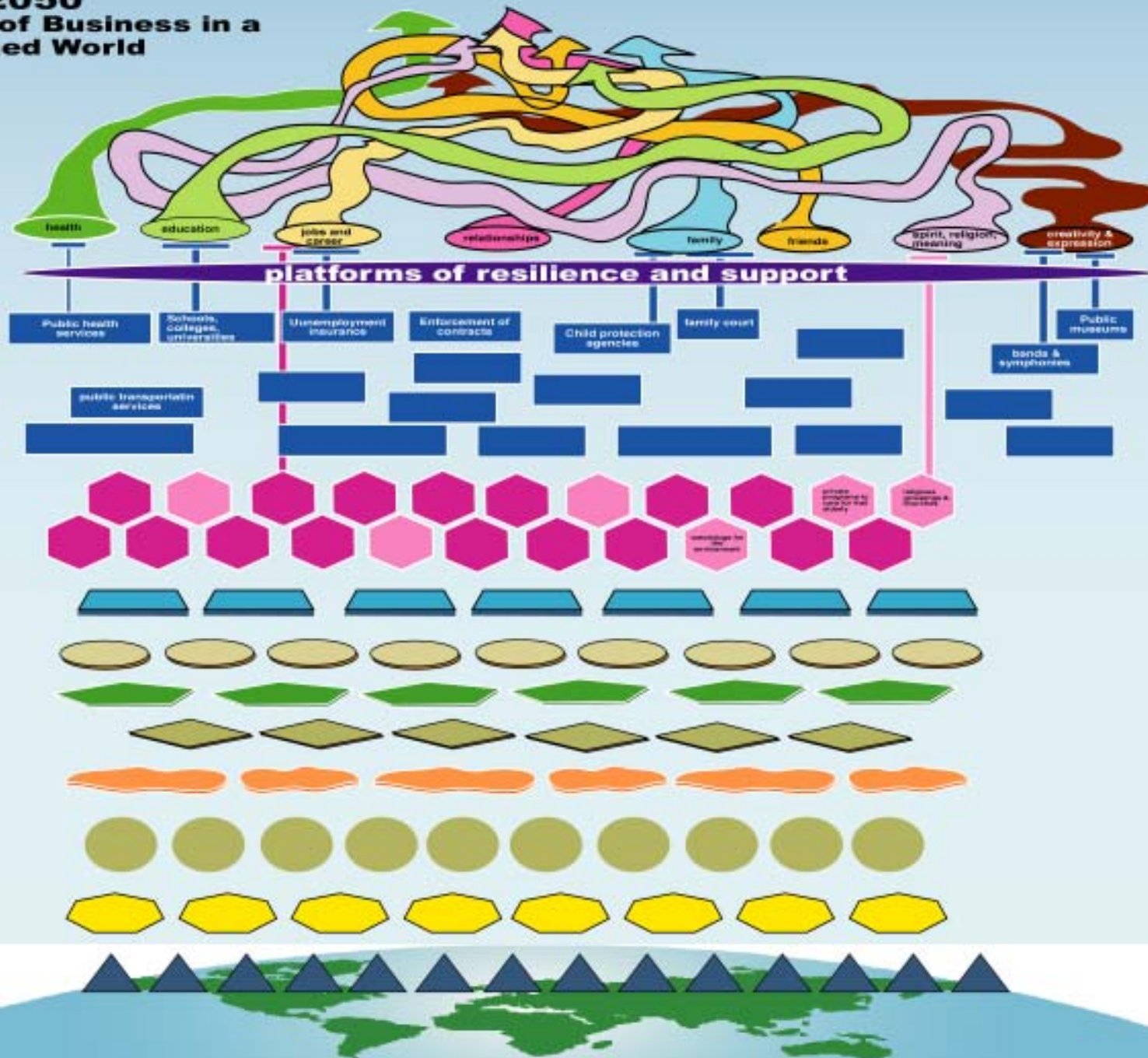
The Field of Challenges for a Sustainable World

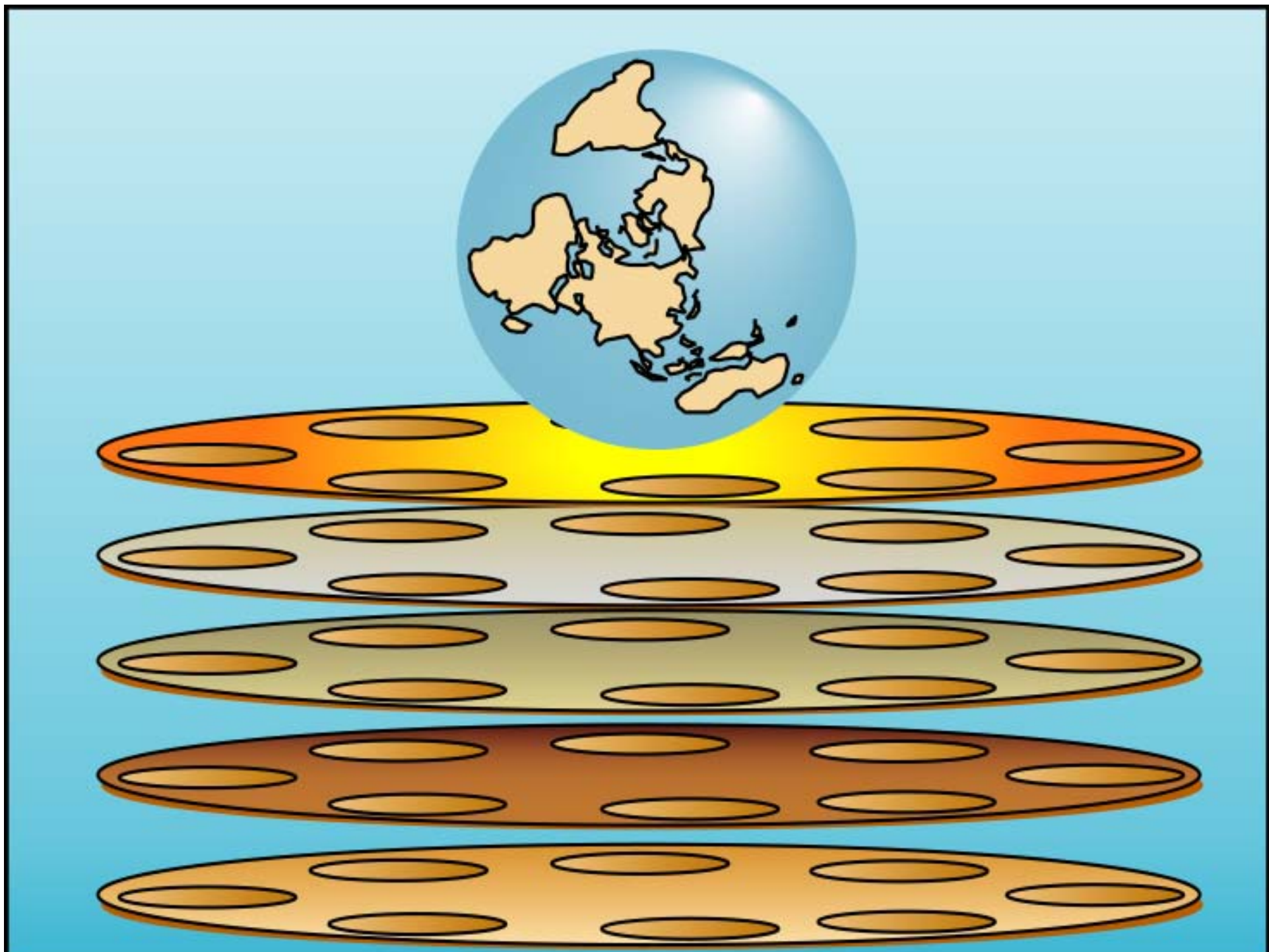


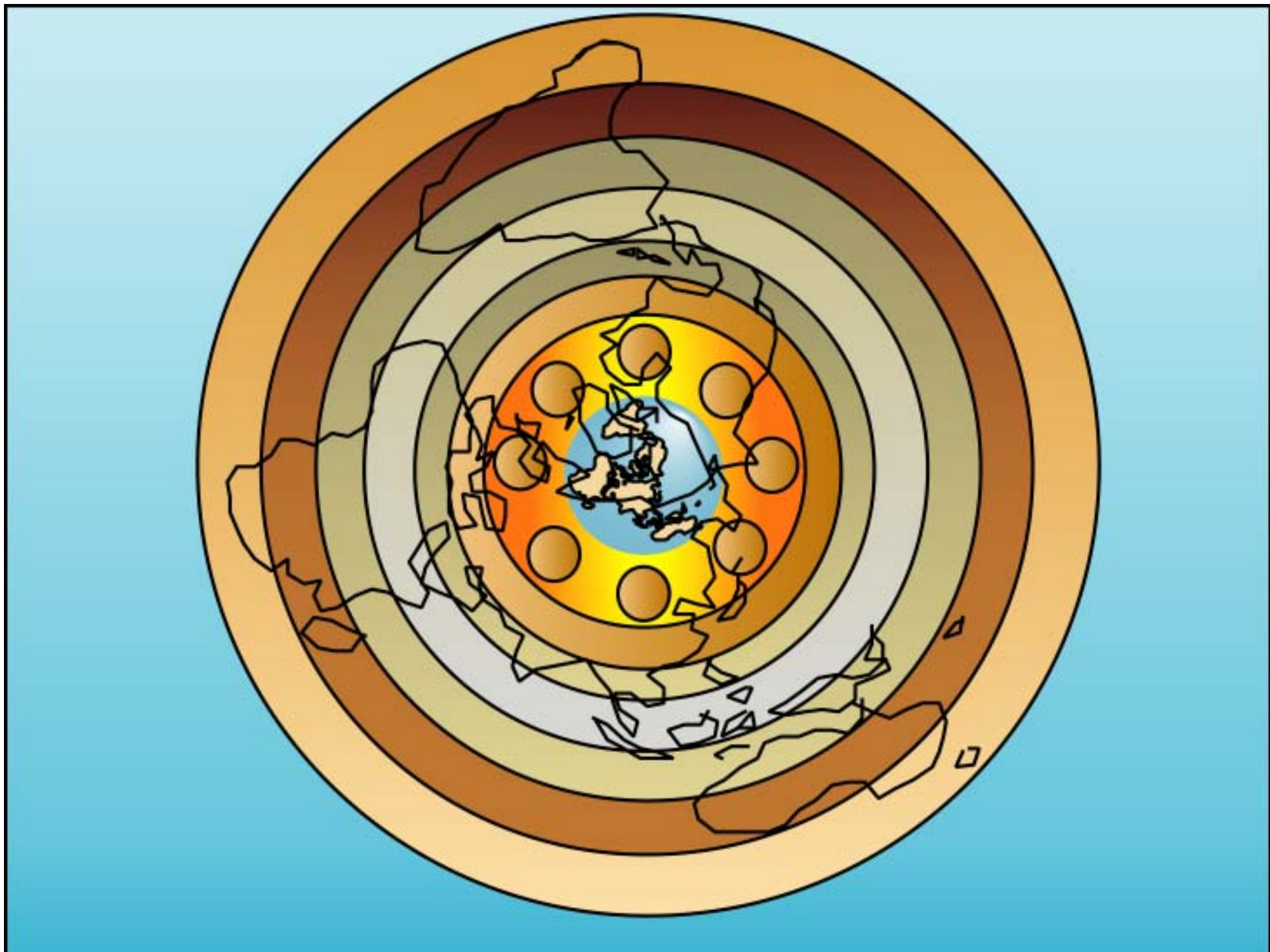


Vision 2050

The Role of Business in a Constrained World







Info-mural Sketch

Sustainable World 2050 - 2100

Large scale narrative of 2050

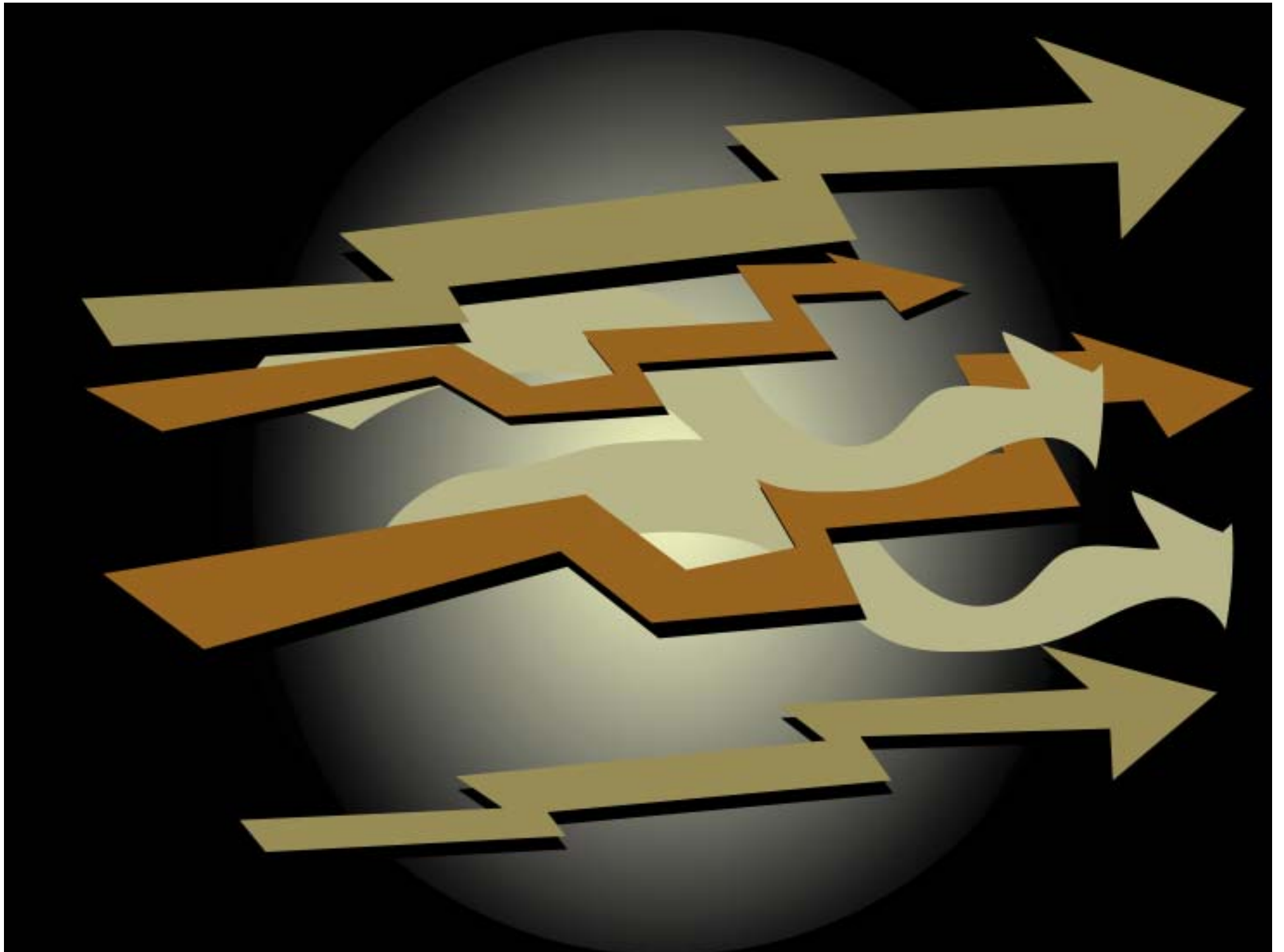
Global footprint analysis

Homeostatic Systems Diagram(s)

Detail of population, carbon, etc

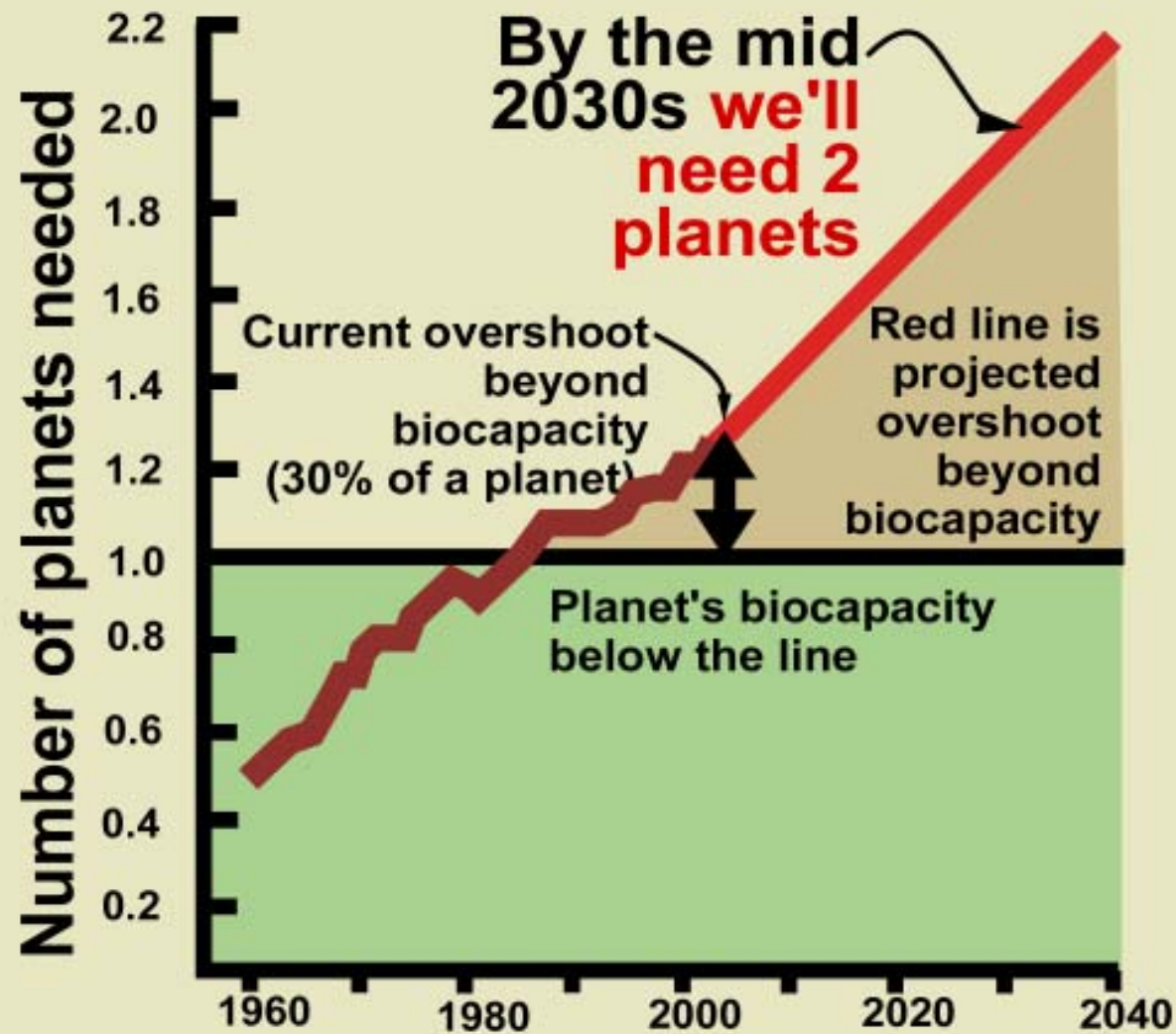
Rationale, assumptions, calculations





**Much of the
"backcasting"
approach we are using
in WBCSD leads us to
the
Governance
Dilemmas**

For the past 20 years, humans have exceeded global biocapacity



Source: Global Footprint Network website (2008)

What's new in governance?

New and different **organizations** have become powerful institutions in the global context

New powerful transnational companies and organizations with their own agendas (e.g. emergence of powerful NGOs and transnational corporations with incomes larger than many nation states)

Overwhelmed by rapid changes in **technology**

Issues are overwhelmed by information and communication technology (e.g. the need to reinvent taxation in e-commerce and the internet)

Policy formation is overwhelmed by rampant, largely unregulated technology (e.g. biotechnology)

Issues of the **commons**

The issues are often management and allocation of common resources belonging to nearly everybody and every nation or to nobody and to no nation. And different aspects of issues encompass different countries

e.g. all the
fish in the
ocean

e.g. all the
atmosphere

e.g.
everybody's
climate

Issues with **long-term, high negative consequence**

The issues are urgent and have a probability of major negative high consequences to humanity and human civilization for hundreds, if not thousands, of years.

NO INSTITUTION REPRESENTS THE GLOBE AS A WHOLE

"nongovernmental organizations have proliferated to represent the interests of civil society, business, labor, and religions on issues such as environmental protection, property rights, workers' rights, poverty reduction, financial stability, and the promotion of democracy and transparency in government. Many of these organizations, both governmental and civil, are effective advocates for the interests that they represent, but none can be said to represent the interests of the world as a whole."

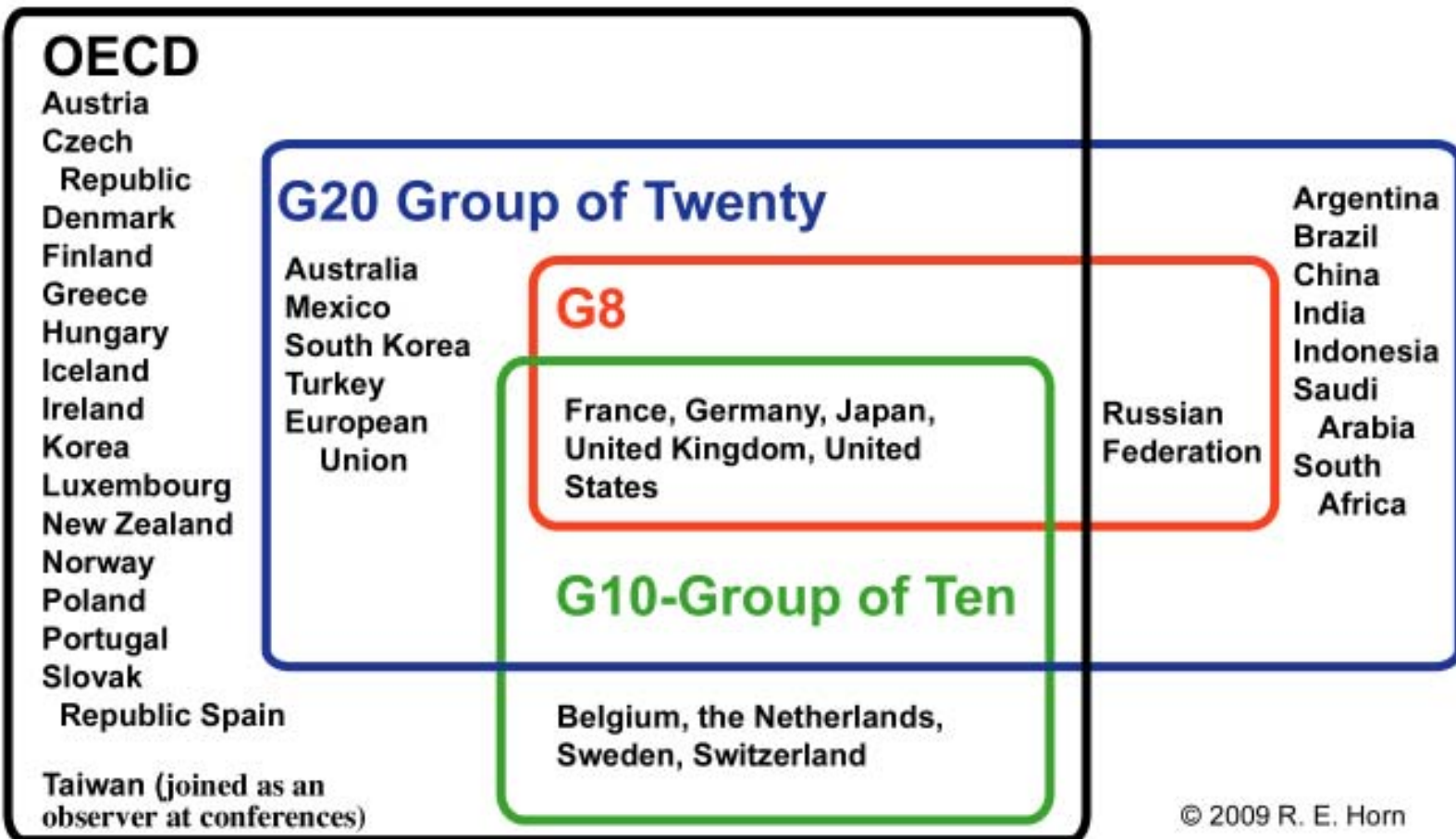


Boughton Bradford (2007)

NO PLACE FOR A CONTINUING CONVERSATION OF WORLD LEADERS ON WHAT TO DO

UNCOORDINATED AND FRAGMENTED GOVERNANCE

No current institutions are available that cover these interlocking issues adequately. There is a lack of a comprehensive system of oversight. Different aspects of the issues encompass different countries and overlapping world institutions and ad hoc groups of states trying to act as executive or steering committees.



NO PLACE FOR A CONTINUING CONVERSATION OF WORLD LEADERS ON WHAT TO DO

**Ad hoc governance groups
(e.g. G8-G20, etc) don't work well
because they don't have
effective, ongoing secretariats, and
mostly meet and issue declarations
and communiques**



NO PLACE FOR A CONTINUING CONVERSATION OF WORLD LEADERS ON WHAT TO DO

COUNTERBALANCING COALITIONS TO THE OECD AND G8 ARE EMERGING

**Shanghai Cooperation
Organization (SCO)** China,
Russia, Kazakhstan, Kyrgyzstan,
Tajikistan and Uzbekistan

**South Asian
Association For
Regional
Cooperation**
Bangladesh, Bhutan,
India, Maldives,
Nepal, Pakistan and
Sri Lanka.

**Association of
Southeast Asian
Nations**
Brunei, Cambodia
Indonesia , Laos ,
Malaysia, Myanmar
(Burma), Philippines
, Singapore,
Thailand , Vietnam

DISFUNCTIONAL INTERNATIONAL MONETARY FUND

Voting. Majority decisions at the IMF require representatives of 35 countries. And U.S. can veto --the only country which can. Any coalition of 3 or more countries with a total vote of 15 % can also veto decisions.

"Changes in the distribution of votes (in the IMF) and influence have lagged far behind the evolution of the world economy, with the consequence that the oversight of the international financial system has become less and less accepted as politically legitimate."

Boughton Bradford (2007)

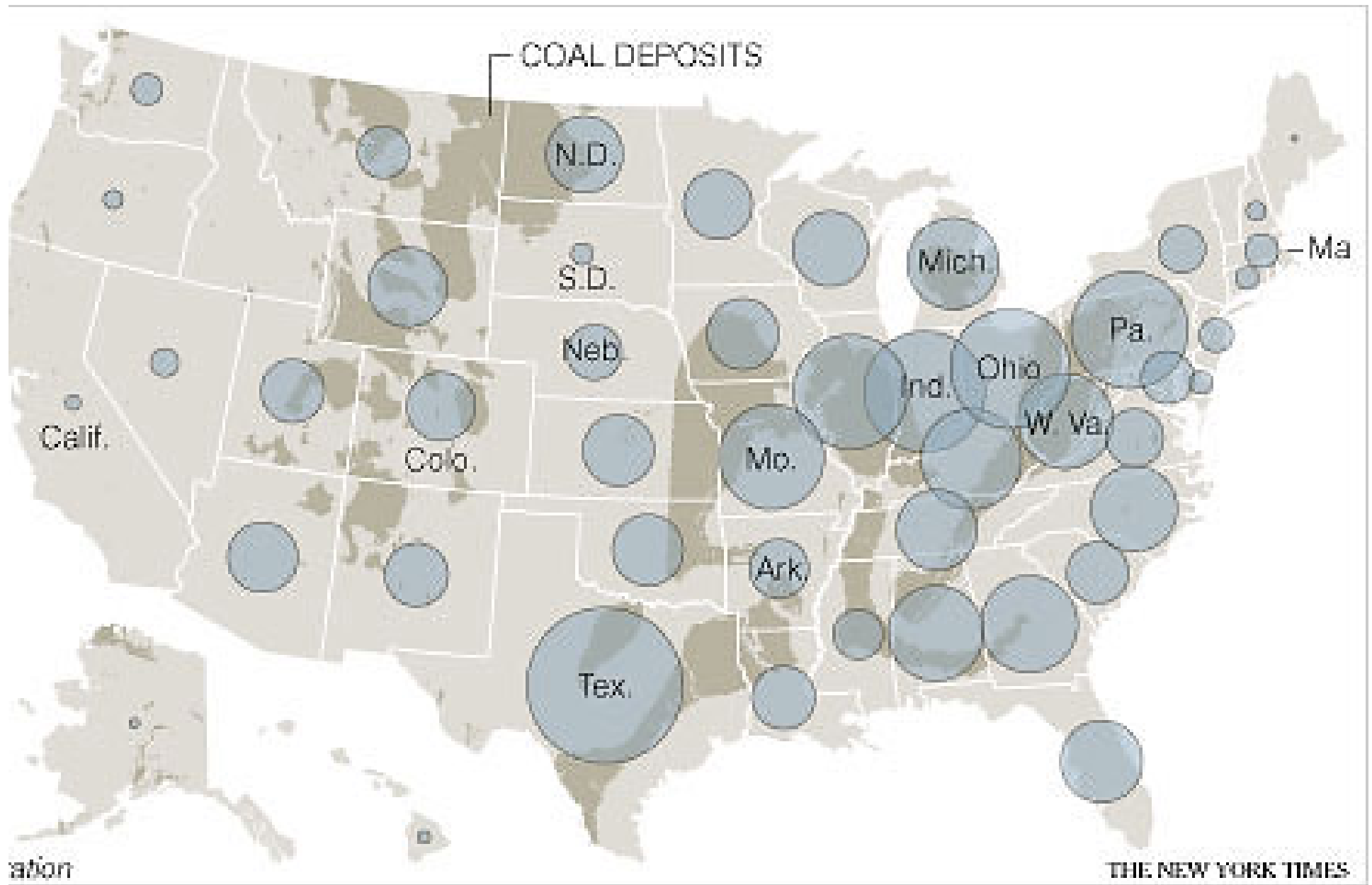


"Solutions" often affect a democratically elected government's ability to maintain commitment from its electorate (e.g. poverty, foreign aid)

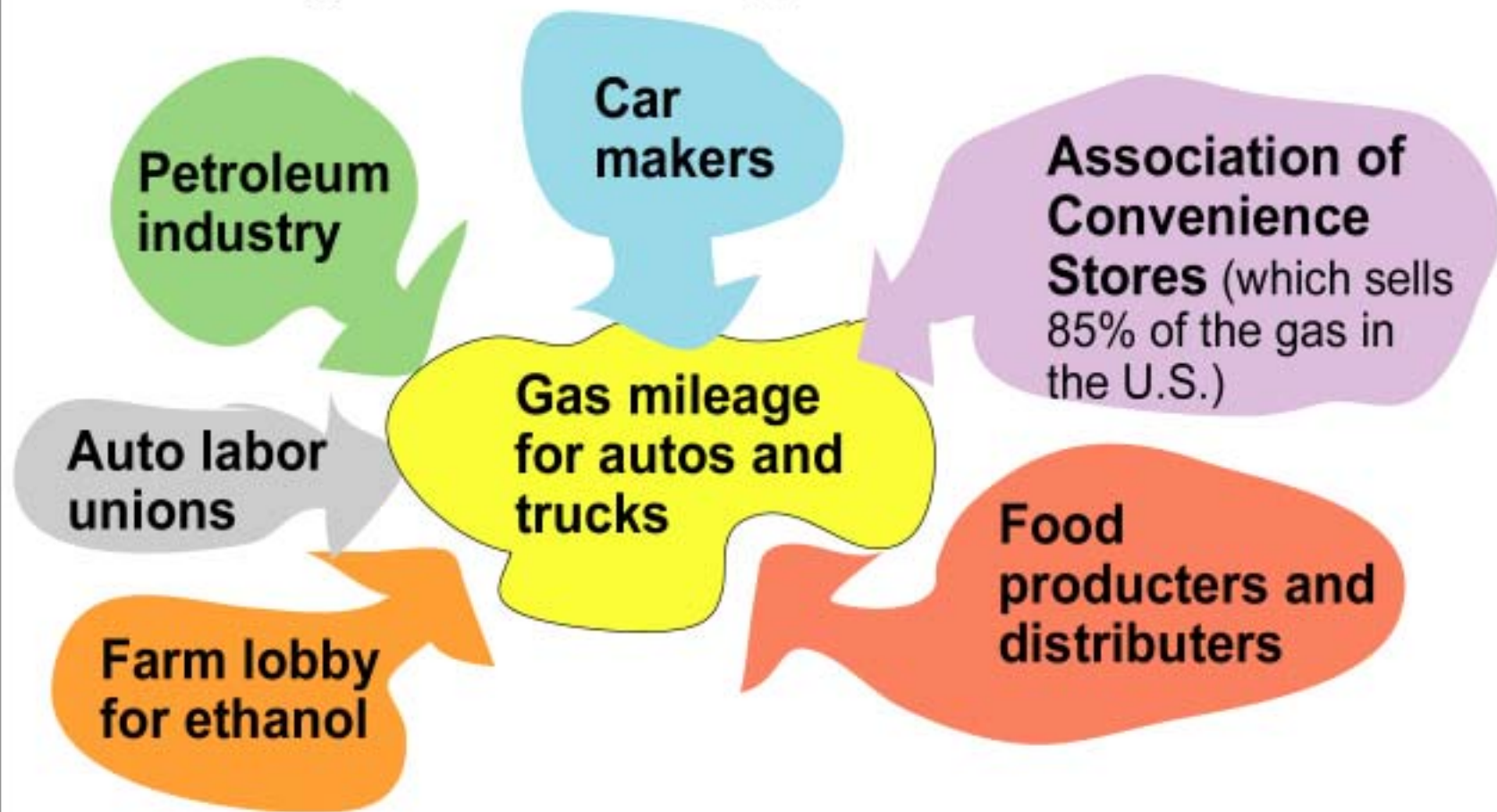


VS

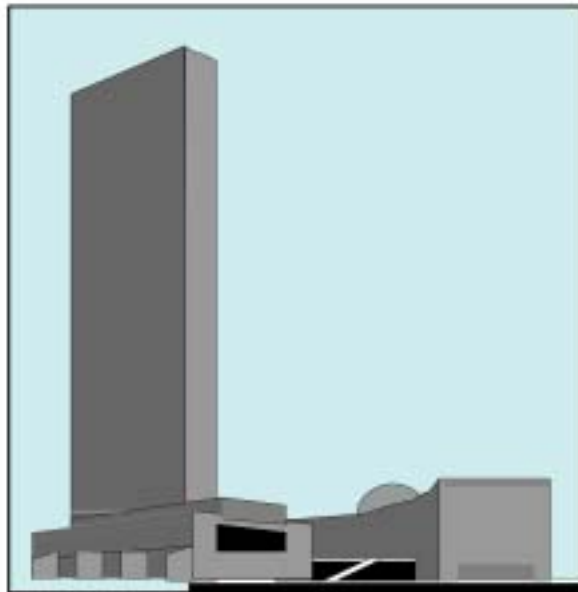




SOLUTIONS OFTEN ARE BENT OUT OF SHAPE BY SPECIAL INTERESTS affecting government decisions by financially influencing elections and regulation



Many UN agencies are weak and underfunded and uncoordinated

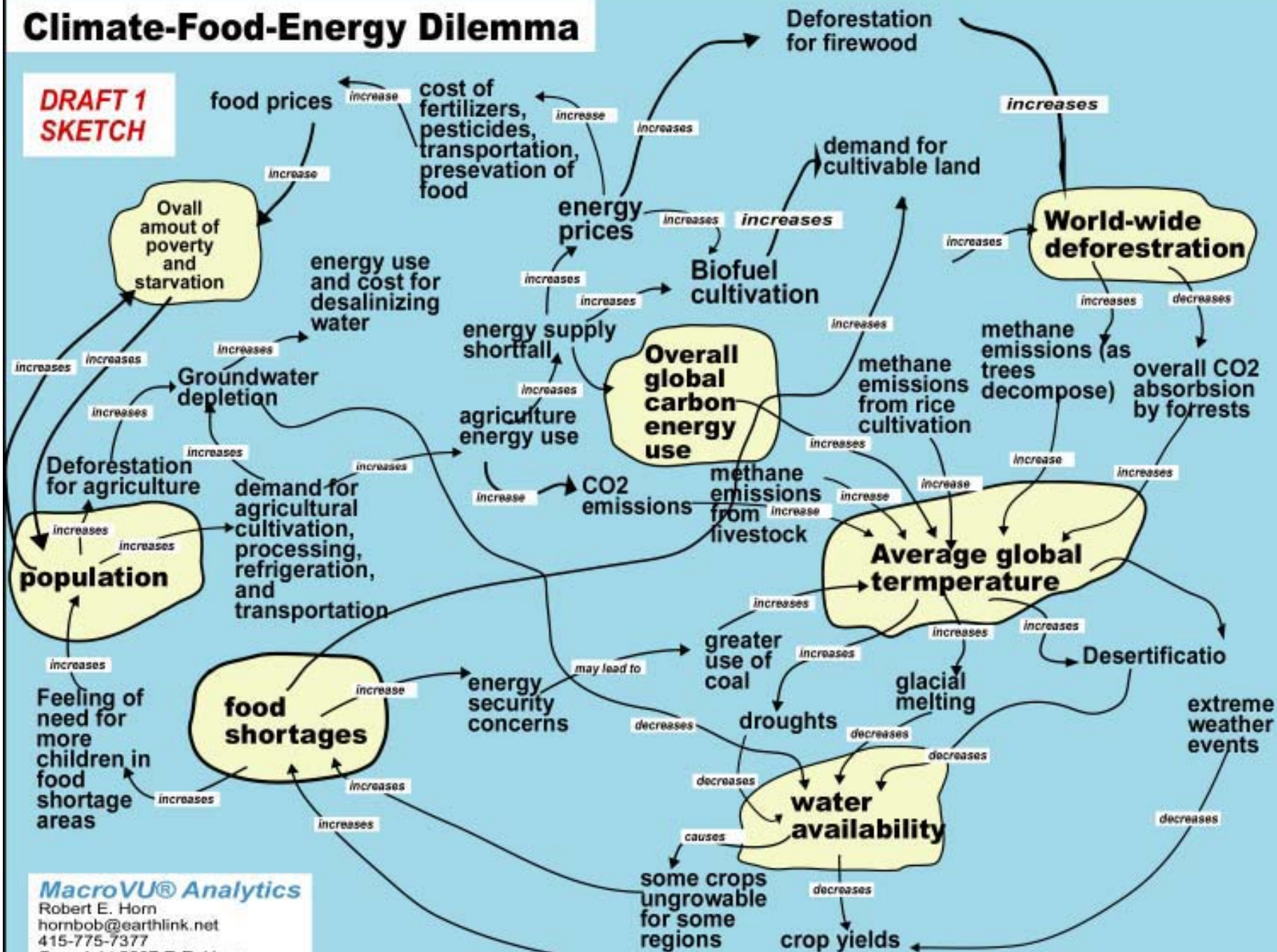


**Perceived
Decline In
Effectiveness
Of United
Nations**



Climate-Food-Energy Dilemma

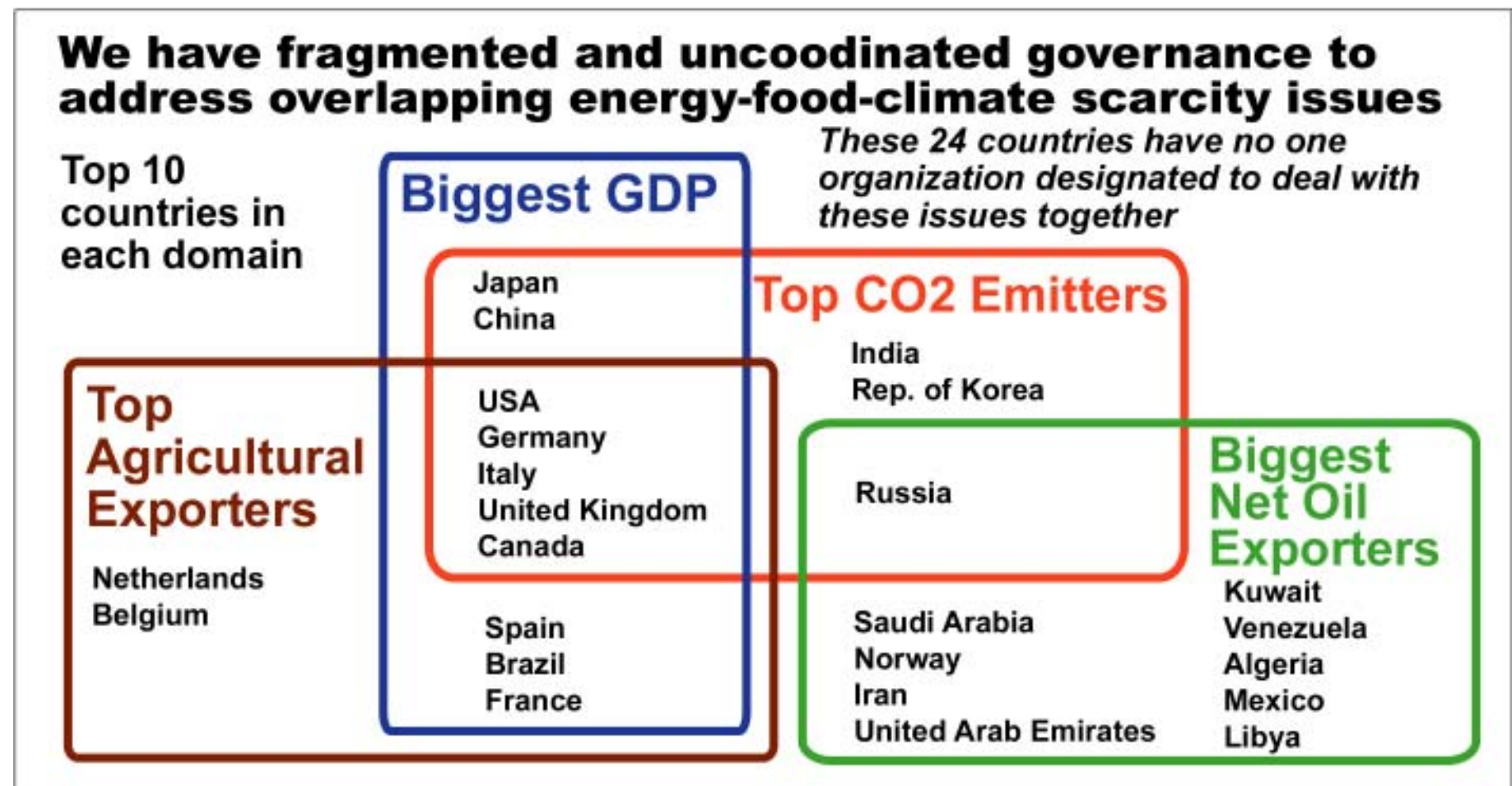
**DRAFT 1
SKETCH**



MacroVU® Analytics

Robert E. Horn
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Copyright 2007 R.E. Horn

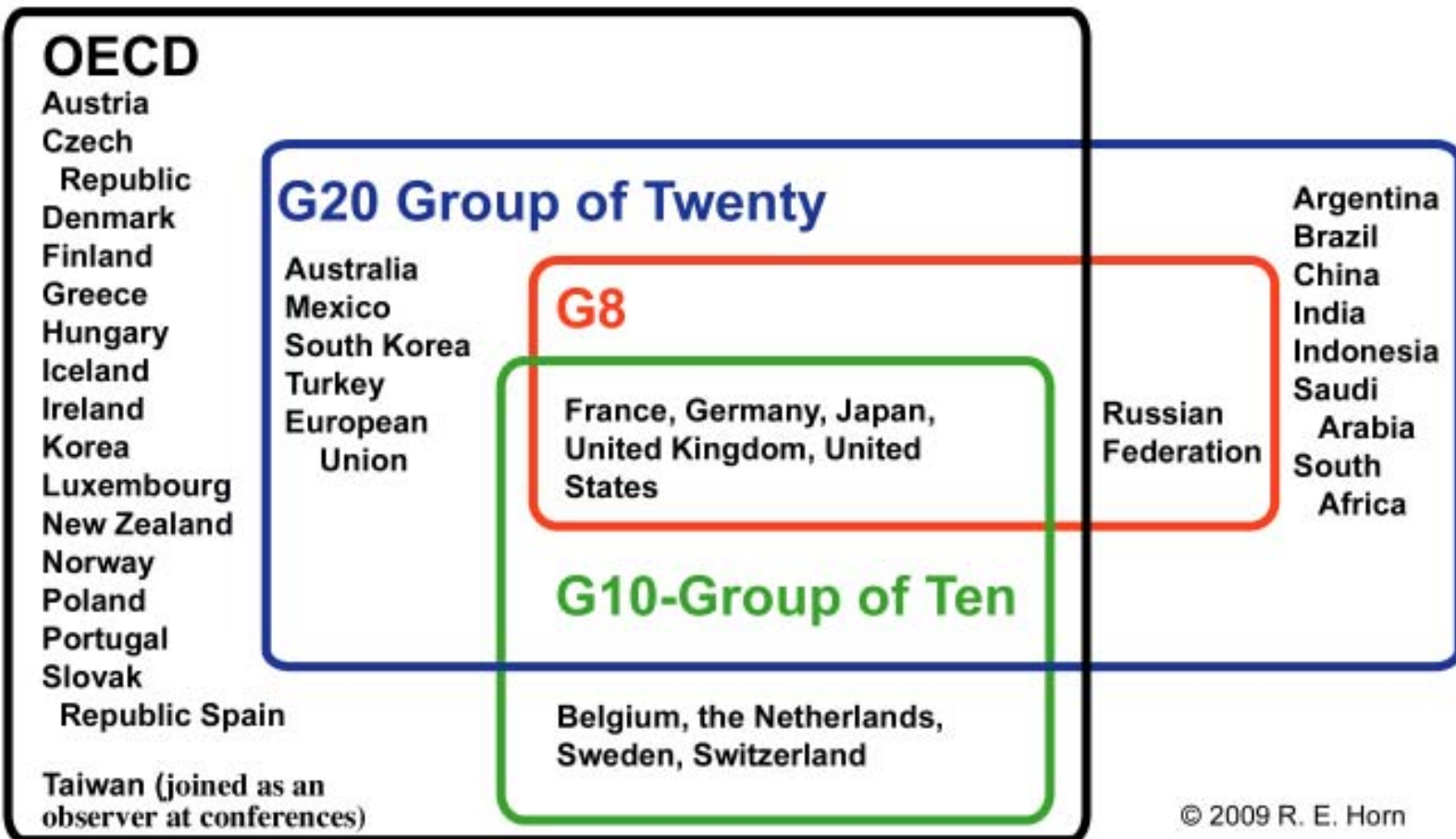
We will have to feed at least 3 billion more people in the next 50 years...with this institutional arrangement



NO PLACE FOR A CONTINUING CONVERSATION OF WORLD LEADERS ON WHAT TO DO

UNCOORDINATED AND FRAGMENTED GOVERNANCE

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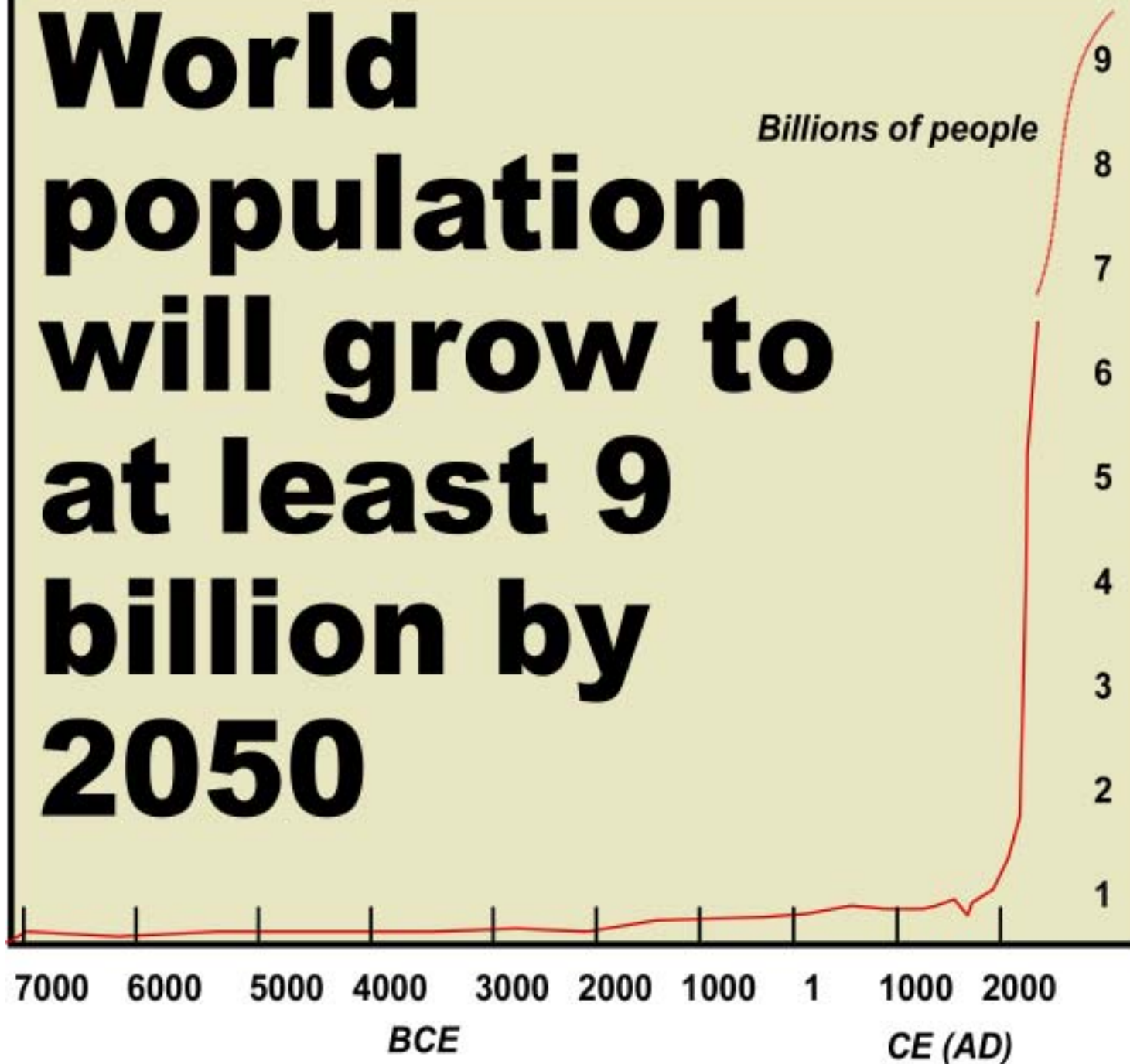


TOO MANY ATTENDEES

**Some institutions are too big
(i.e. are conferences (eg
Conferences of the Parties
(COPs) under the Kyoto
Protocol) attended by ten
thousand people**

**10,000
attendees at
COPs**

**World
population
will grow to
at least 9
billion by
2050**



however because of

**objections of some parts of
some religions...**

and because of

inadequate funding...

***It is difficult (or close to impossible) in some
countries to improve women's rights and
female empowerment because they won't***

**create public awareness campaigns
on contraception**

make available legal abortions

**provide access to free or low cost contraception
(the pill, intrauterine devices, injectables, implants)**

educate young girls through secondary school

Recent Diminishment of Power on National Level



In the past 60 years, the nation-state has decreasing control (in different amounts in different states) **over...**

...domains of commerce and society ...for example

the effects other countries have on its climate

acid rain coming across

plants and organisms to enter and leave the country

movement of drugs and power of drug cartels

control over biotechnology r&d

pollution arriving from the other side of its borders

the use and quality of its nearby oceans

its ability to tax information age services and products

the ability to control the international agenda, slipping away to new media and NGOs

news and information coming and going across its borders

its borders and illegal immigration the value of its currency

its ability to feed its citizens

the language used in official transactions

...strategic thinking is now often done outside government ...for example

policy analysis

formation of strategy

forecasting

data collection

long range policy planning

...economic decisions ...for example

ability to move capital across border

Proposition 13 in California and other grass roots tax revolts

lobbying strength

stronger countervailing power of large corporations

transnational corporate power

...functions contracted out ...for example

educational vouchers

semi-privatizing of US Postal Service

production of military weapons

collection of withholding tax

contracting legal services to poor advanced research and development

the safety of inhabitants (to private police)

state and local initiatives of environmental regulations

Recent state initiatives on crime, drugs, education and welfare

providing logistics and protection in wars

...sovereignty delegated to international organizations ...for example

amount of certain CFCs and other pollutants to be emitted

weather forecasting

allocation of electromagnetic spectrum

Human rights charter and Helsinki accords shake control over agenda for in-country rights

...its ability to govern in secret

open government initiatives

consumer lobbies

rapid increase in capabilities of NGOs

public interest law firms

open source concepts

Freedom of Information Act

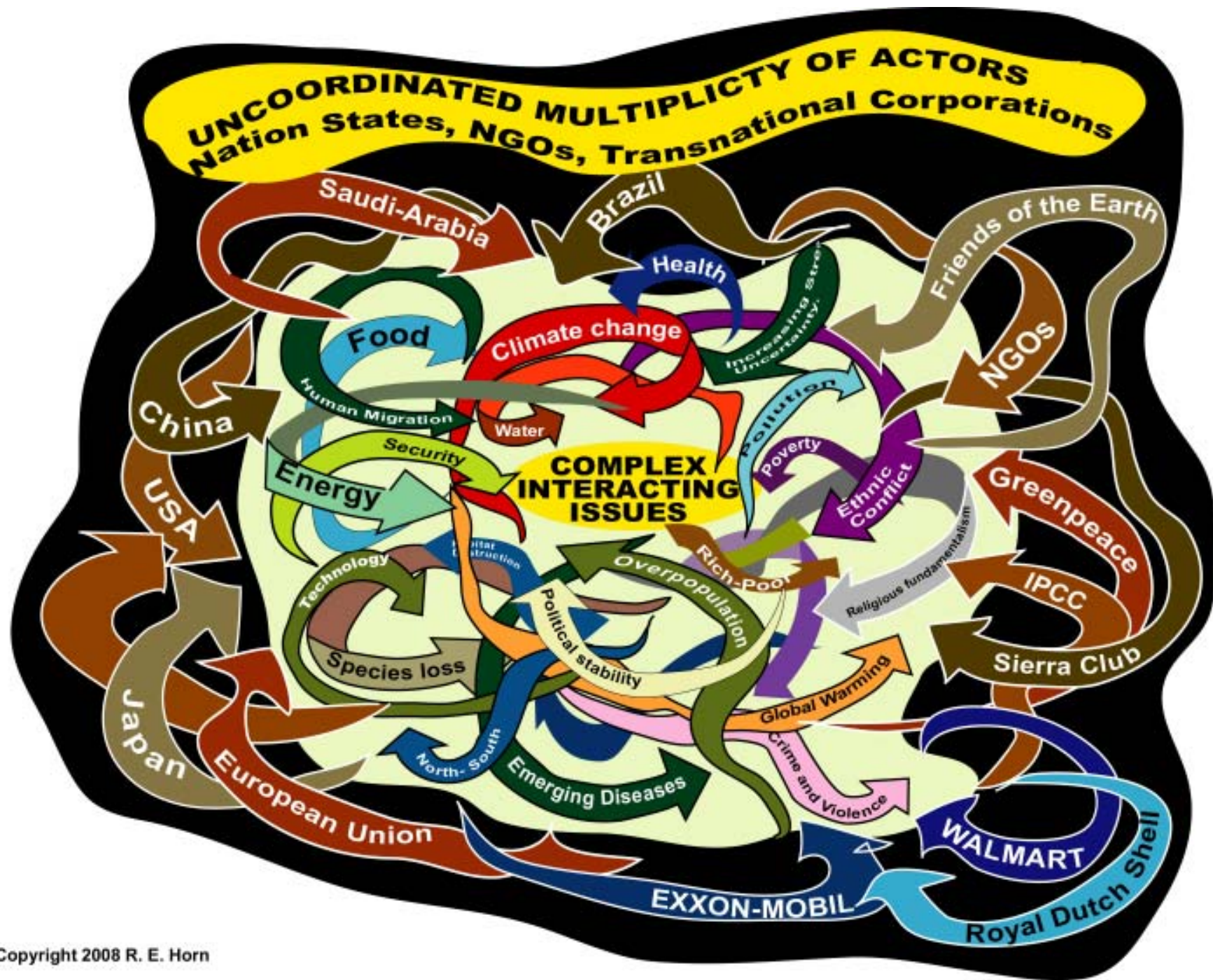
Key
This is an abstract diagram.
Not every sub-unit is explicitly all of these functions.

The direction of arrow indicates direction of movement of control.

Cleveland, OH, (1995) Birth of a New World: An Open Moment for International Leadership. San Francisco: Jossey-Bass Publishers.
Smith, J.D. (2006) The Edge of the World: Capitalism, the Environment, and Crossing from Crisis to Sustainability. New Haven, Conn.: Yale University Press.

DRAFT v.2

MacroVUE Analytics
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415-775-7377 Copyright 2008



TREATIES DON'T WORK FAST ENOUGH.

Some existing practices (eg. treaties) don't work well because they take too long to create, ratify, and implement and are easily renegged on.

Example: Kyoto Protocol

History: Originated in Rio 1972

Signed :1997

Ratified by enough countries to go into effect in 2005 (when Russia ratified)

Terminates in 2012

Annual Conferences of the Parties (COPs) have so far failed to make significant progress on next treaty

Implementation. Many of signatories are failing to meet their obligations to reduce CO2 emissions agreed to in the treaty.

Climate solutions involve equity / fairness issues

There are (at least) three principles that can be used to allocate costs and rights in climate change, each of which lead to dilemmas

- 1. Equal percentage reduction of greenhouse gas emissions for all countries**
- 2. The polluter-pays principle would require agreed reductions according to the amount of greenhouse gas emissions principle**
- 3. The rights to emit per capita principle would give every person in the world a certain amount of greenhouse gas emissions per year**

LACK OF RELEVANT EXPERTISE. Expertise to think about the interlocking issues and manage them often exists only (or more) in other institutions than governments (e.g. NGOs, business, universities)



ISSUES ARE COMPLEX AND NOT AS WELL UNDERSTOOD AS REQUIRED

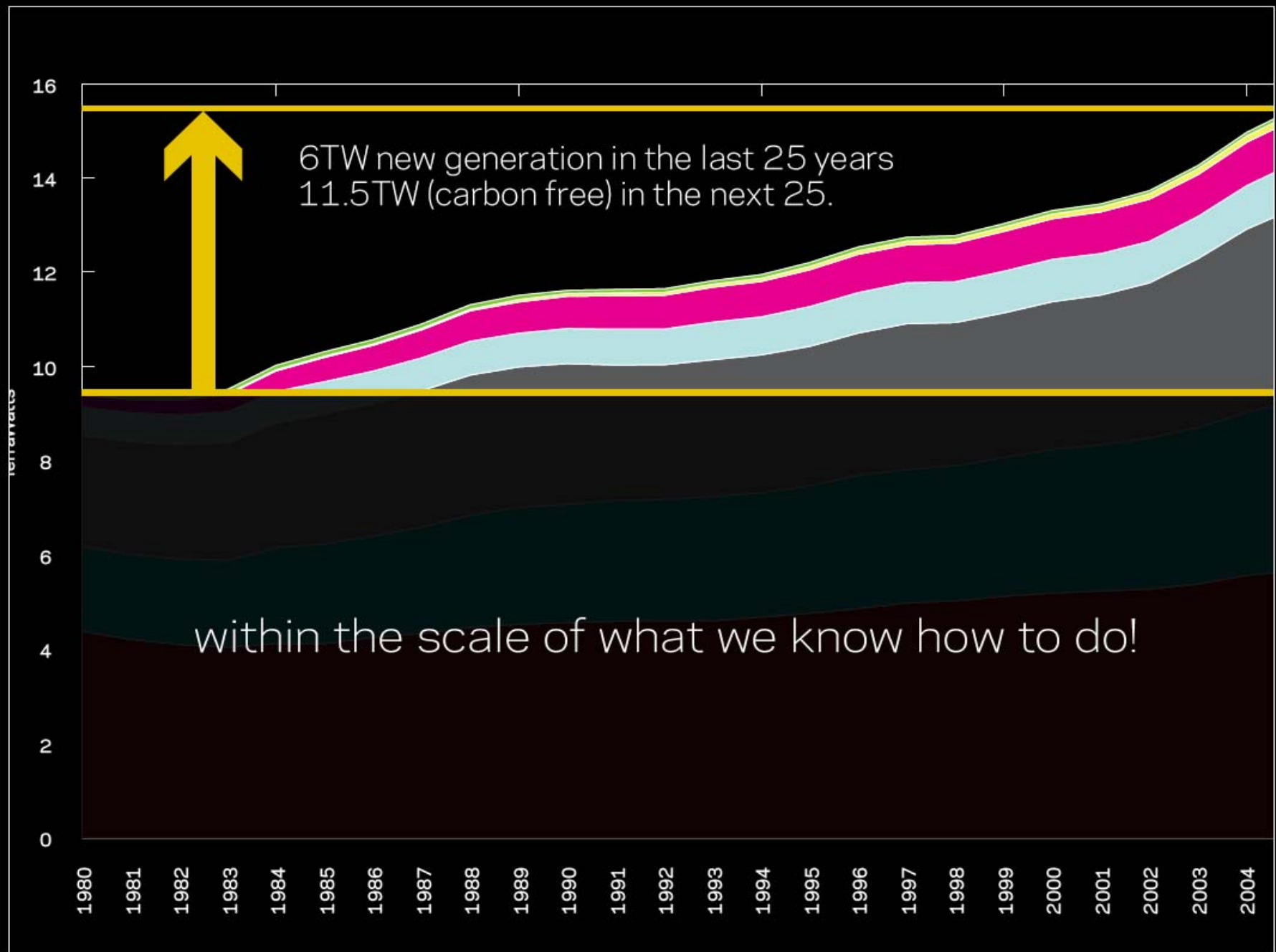
The issues are so complex that scientific methods and practice are maturing but need more work and the uncertainties are considerable. Often academic disciplines do not have the ability to integrate their analyses and vocabulary easily.



Crisis and Creativity

Mitigation strategies, from conventional to radical
(predicated on a significant carbon price)

- Efficiency and conservation
- Renewables (GSHPs)
- Coal with CCS and nuclear
- Unconventional technologies (UCG, enhanced geothermal, stratospheric windmills)
- Atmospheric carbon capture
- Geoengineering
- Shifting away from conventionally defined “growth”



BREAKING GLOBAL DEADLOCKS: WHO'S AT THE SUMMIT?

September 25, 2007
New York City



THE "DEAL"

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Persuading your Leader it is a Good Deal.....	7
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The Group of 8 Leaders summit (G-8) has not been able to make the breakthroughs necessary to develop vitally needed global public policy. A larger and more diverse group, somewhere from thirteen to twenty, could build on the G-8's strengths of informality and flexibility, providing a valuable supplement to the United Nations. The "Gleneagles 5" - China, India, Brazil, Mexico and South Africa - are meeting with the G-8, but only for part of the latter's meeting. Instead, full and permanent participation is required. It is also difficult to imagine such a meeting without an Islamic country present; adding one makes for a minimum of fourteen countries.

A larger summit that includes industrialized and developing nations could make progress on acute global problems in cases where no other existing international forum can. It could break gridlock in climate change, health, and conflict management, among others. The number and identity of countries can be debated, although experience suggests a maximum of approximately twenty, if meetings are to be effective. Former Prime Minister Paul Martin has proposed a group of twenty - the Leaders 20 (L20).

A more effective summit system could deliver solutions to many problems. New approaches are most urgently needed in the area of climate change. Serious responses to climate dangers require a decision making body with representation from both North and South. Only leaders can make the tradeoffs among the cross-cutting interests in a potential deal. A universal forum cannot, on its own, deliver success - only leaders working in a small group can manage the complexity and generate breakthroughs. The draft package that follows illustrates the "deal" that a new group of L14 leaders could reach - an integrated set of decisions, invitations, and mandates.



Consejo Mexicano de Asuntos Internacionales, A.C.



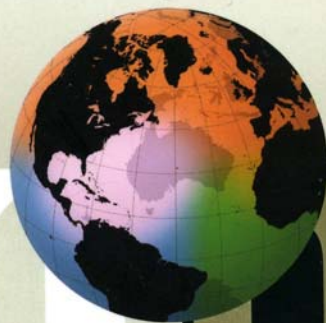
The Centre for International
Governance Innovation
Centre pour l'innovation dans
la gouvernance internationale



HIGH NOON

"Rischarde brings a new perspective to global environmental issues facing our planet [and] offers a thought-provoking and somewhat nontraditional approach to global problems and solutions."

—CHOICE



20 GLOBAL
PROBLEMS

20 YEARS TO
SOLVE THEM

J.F. RISCHARD

Summary

- **Urgency of climate situation (helicopter view)**
- **Complexity of policy**
- **Visual tools: info-murals**
- **World Business Council for Sustainability Project**
- **We can meet the climate and sustainability challenge**
- **Governance dilemmas are the hardest**

How to Contact

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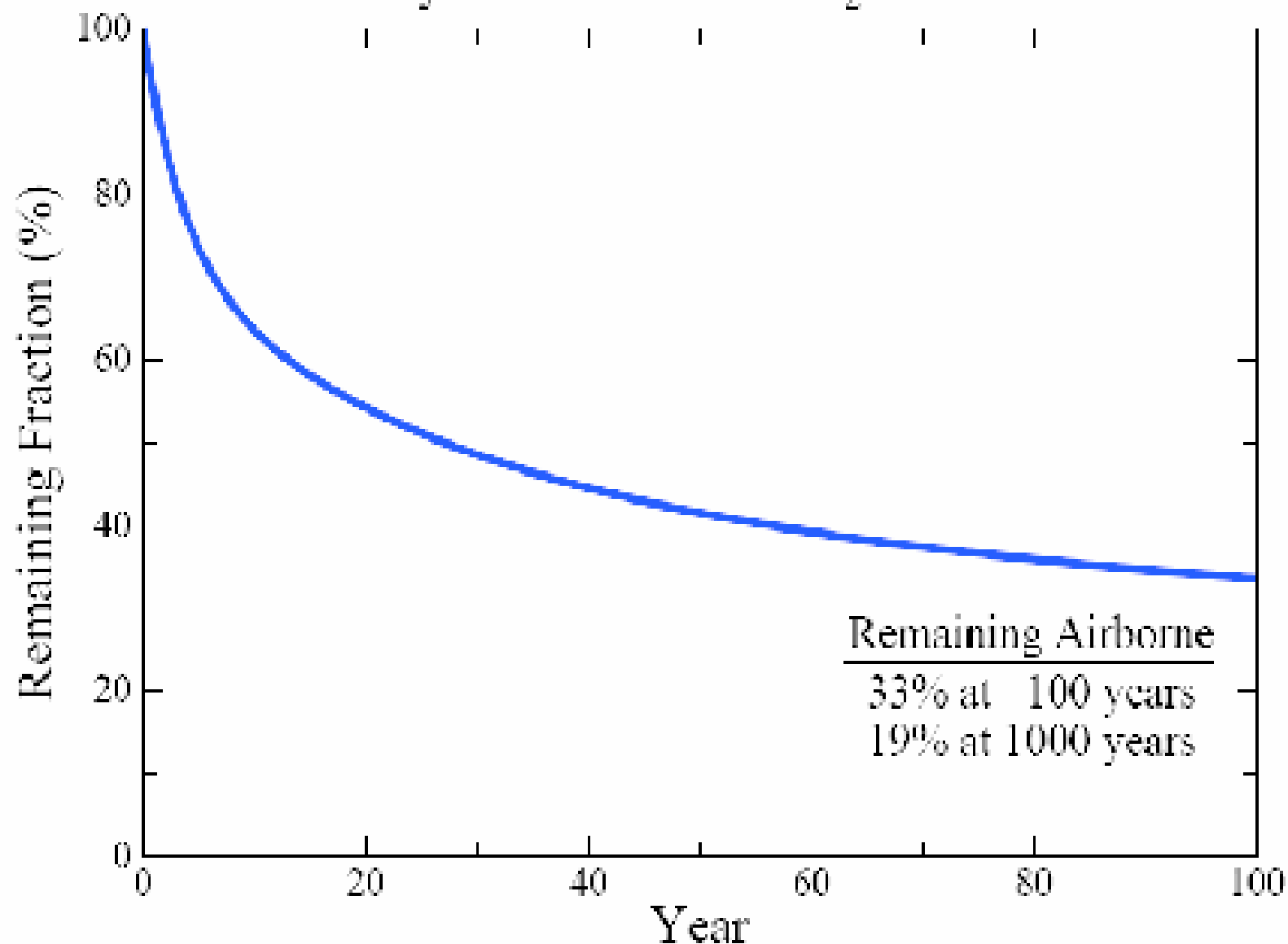
For more info on Visual Language book

<http://www.xplane.com/visuallanguage>

for more on Bob Horn's current work (well a little out of date):

www.stanford.edu/~rhorn

Decay of Fossil Fuel CO₂ Emission



Hansen, *Atmos. Chem. Phys.* 7 (2007):2287-2312.

Step 1 CO₂ = Climate

450ppm

Step 2 Temperature Choice

+2 C This acknowledges huge species lost, water shortages, and sea level rises. Risk of vicious cycles (what climate scientists call positive feedback).

Step 3 Allowable Carbon

2 GtC / year into atmosphere.

Step 4 Useable Fossil Energy

2 TW (can go up or down a little depending on source)

Step 5 Clean Energy Sources

There is plenty, and the big players look like nuclear, solar, wind, and geothermal.

Step 6 New Energy Mix

11.5 TW of clean energy. 3TW Nuclear, 2TW PV, 2TW Solar thermal, 2TW wind, 2TW geothermal, 0.5TW clean biomass..

Step 7 Turn off majority of existing carbon fuels.

ONE ENGINEER'S CALCULATION OF A New Energy Mix to get to 450 ppm by 2050

Needed 15 TW (our current consumption) that is 2244 Watts average person consumption.
Allow 2 TW of carbon emitting energy (maybe 4 TW)
We already have 1 TW of Nuclear and
0.5 of "renewables"

PHOTOVOLTAIC

100 m2 of solar cells every second for the next 25 years. 15% efficiency, good sitting.
30% efficient solar thermal "power towers"

SOLAR THERMAL

2 TW New Solar Thermal
50m2 of solar thermal mirrors *every second* for the next 25 years. 30
30% efficiency, well sited

WIND

2 TW New Wind
12 - 3MW wind turbines in great locations every hour.
Or one 100m diameter turbine every 5 minutes...

NUCLEAR

3 TW New Nuclear
1 x 3GW nuclear plant every week for the next 25 years.

GEOTHERMAL

2 TW New Geothermal
3x 100MW steam turbines every day for next 25 years.

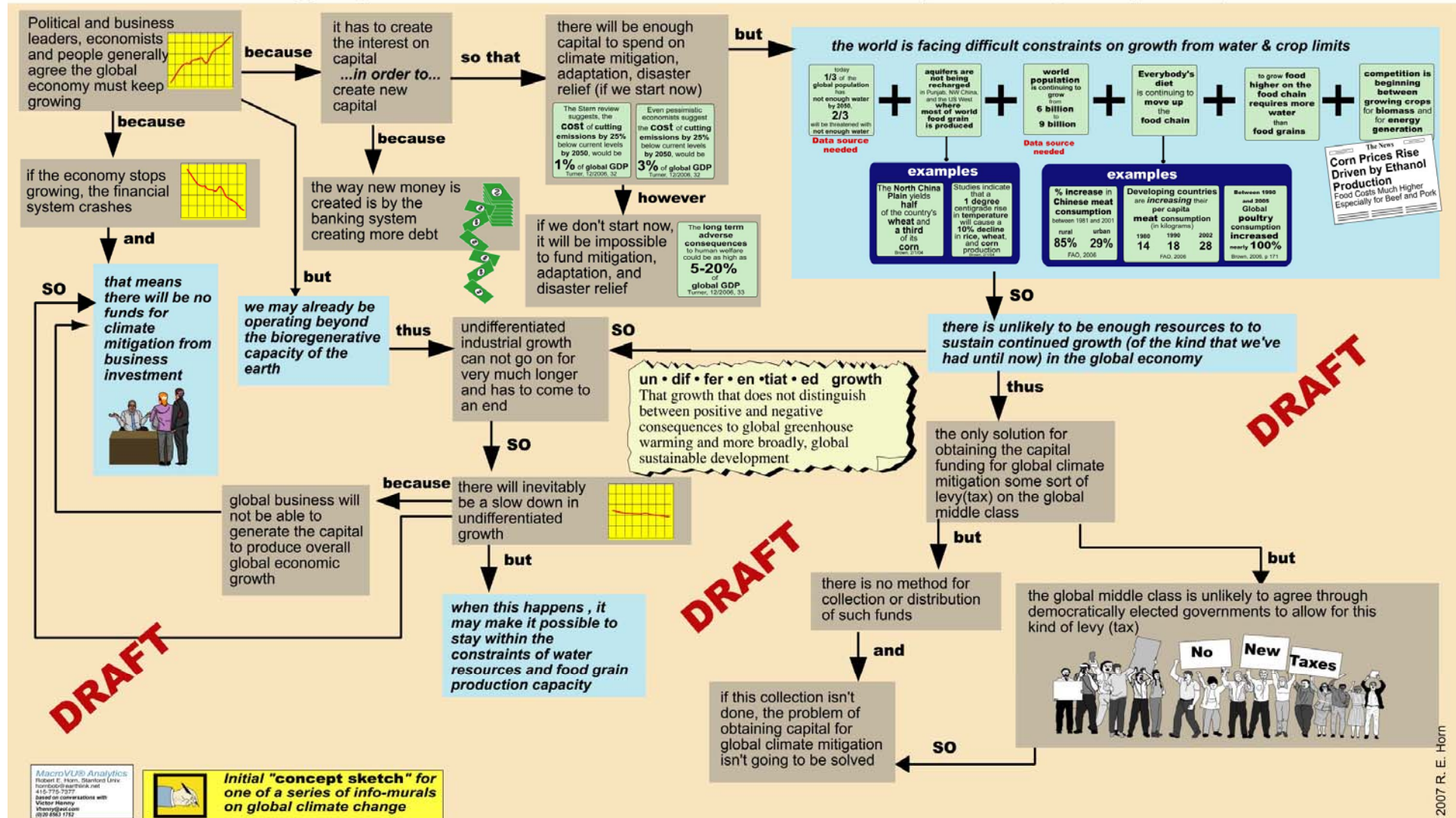
BIOFUELS

Assume a really good 1% efficient algae. recognise this technology isn't ready yet.
0.5 TW Biofuels, Tidal Power, Wave Power.
0.5 TW carbon (net zero) biofuels?.
1250 m2 or 1 olympic swimming pool of algae every second for the next 25 years.

WE ALSO NEED

0.5 TW of wave, tidal and biofuels

Global Warming Dynamics -- Dilemmas of Food, Water, Capital, Taxes



Global Climate Dynamics - Will the World React in Time? Dilemmas of Democracy

There is a high likelihood governments will fail to act in a timely manner to prevent global climate change

For example...



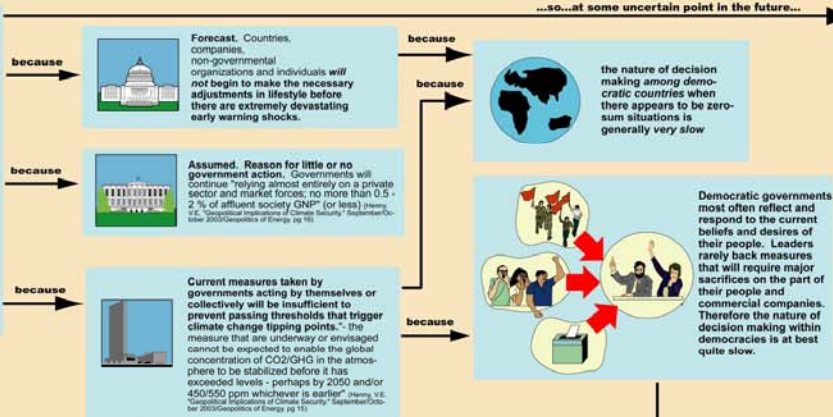
Agreement on the next international treaty on emissions controls (post-Kyoto) will take a long time



Transition from oil to alternative fuels in transportation sector will move too slowly



Electric power industry will continue to invest in high-CO2 generating coal plants for a considerable time



Globally intolerable incidents will begin to occur. There will likely be one or more early warning shocks (EWS) in the 2010-2015 timeframe (like Hurricane Katrina). When there are sufficient early warning shocks close enough together to produce globally intolerable impact clusters, country leaders and their populations will be frightened enough to act. They will finally really believe what scientists in the IPCC have been predicting.

Definition. Globally intolerable events.
Globally intolerable events "can be defined as any or all of the following becoming an annual occurrence - material damages in excess of \$500 billion [or] - more than 30 million displaced persons, or] - additional directly or indirectly caused deaths over 10 million" (Henny, V.E. "Geopolitical Implications of Climate Security" September/October 2003/Geopolitics of Energy, pg 16)

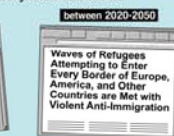
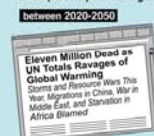
Criteria for globally intolerable events



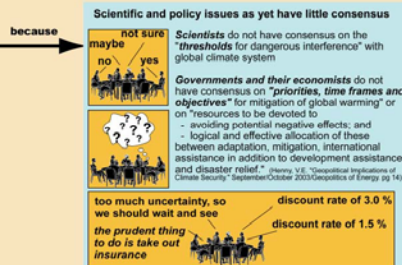
Compare with Hurricane Katrina (USA) 2005



Examples of plausible globally intolerable events



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The global middle class has this general set of beliefs about climate change and its mitigation

Invisible hand of the market

The market is the best way to mitigate consequences

The global middle class have almost complete "confidence that market forces can be relied upon to make logical and effective allocations of available resources to mitigation and adaptation" and that some minor international assistance may be needed for development assistance, and disaster relief." (Henny, V.E. "Geopolitical Implications of Climate Security" September/October 2003/Geopolitics of Energy, pg 14)

The global middle class believe that all of the "global community should be continuing to pursue maximum economic growth of similar conventional material types." (Henny, V.E. "Geopolitical Implications of Climate Security" September/October 2003/Geopolitics of Energy, pg 14)

The global middle class does not believe there is any urgency to the imminence and potential disastrous consequences of global warming. Such probability is "so low that there is as yet no justification or felt need for [them] to abandon any significant advantages gained through unsustainable development so far...or to agree to the raising of fresh public resources, or transfer of these to other countries on other than commercial terms." (Henny, V.E. "Geopolitical Implications of Climate Security" September/October 2003/Geopolitics of Energy, pg 14)

To meet the needs of poverty eradication, the global middle class believe private market forces will provide the means to achieve sustainable development.

The global middle class believes that even if catastrophic event happen, there will easily be sufficient time for remedial action.

The global middle class believes that the level of danger from global warming is not sufficient for them to change their lifestyles. If they've thought about it at all, most of the global middle class believe it will be possible to go way beyond 450/550 ppm in 2050 using existing approaches and lifestyles before encountering sufficiently dangerous interference with climatic, environmental or socio-political systems" that might produce catastrophic futures.

The global middle class consists of about 1.2 billion people. About 34 are in the Northern developed countries and 1/4 in the underprivileged, mainly Southern, countries.

These dynamics will provide part of the basis for creating a business as usual scenario.

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Initial "concept sketch" for one of a series of info-murals on global climate change

Climate solutions involve equity / fairness issues

There are three principles that can be used to allocate costs and rights in climate change, each of which lead to dilemmas

1 Equal percentage reduction of greenhouse gas emissions for all countries principle

Many countries with large populations and developing economies (e.g. India, China, South Africa, Brazil, Indonesia) will not agree

because

...this would stop their growth and unfairly punish their people compared with the developed countries

and because

...the costs for this would be especially high for countries using coal for energy production (China, India, U.S., Australia, many East European countries)

and because

...some countries, notably Japan, have such a low energy intensity that is 30 - 40 % below other developed countries because Japan has been cutting its energy use for many years

Climate solutions involve equity / fairness issues

There are three principles that can be used to allocate costs and rights in climate change, each of which lead to dilemmas

2. The polluter-pays principle would require agreed reductions

means that rich countries would pay most costs because they have contributed most emissions historically to the atmosphere and developing countries would increase their share of costs as their economies grow

BUT...

...this would be unfair because it denies equal rights of economic progress to all countries (and especially unfair to developing countries)

AND...

...fair methods for allocating these assessments for previous historical emissions run into difficult questions:

Would the historical-based assessments be based on per capita emissions, time-based emissions, total amounts? Would the current populations of countries be willing to accept obligations of their ancestors?

Climate solutions involve equity / fairness issues

There are three principles that can be used to allocate costs and rights in climate change, each of which lead to dilemmas

3. The rights to emit per capita principle would give every person in the world a certain amount of greenhouse gas emissions per year

BUT...

...this would involve a larger current taxation on developed OECD countries than on more populous countries

AND...

...this would predictably move energy-intensive industries to countries with large and economically poor populations

BUT...

...maybe such moves could be reduced by new tariff regulations in international trade agreements

BUT...

...this would likely not work because it would impose a tax on rapid population growth

Climate solutions involve equity / fairness issues

The free-rider (or prisoner's dilemma) Issue in climate change

A country cannot stop others benefiting from their reductions of green house gas emissions, thus creating a free-rider problem in which other states can benefit without cutting their own emissions. Since there are costs to reducing emissions, states will want to avoid cutting their own emissions until they can be sure that others are bearing fair, commensurate costs.

BUT...

This means coming up with a principle of fairness about the costs.

AND...

It means that solving the problem requires overcoming the prisoner's dilemma. All states need to be assured that others will also cooperate or their rational decision is to continue emitting until other state also stop.

...but... World population could be stabilized if this interdependent set of challenges are met...

