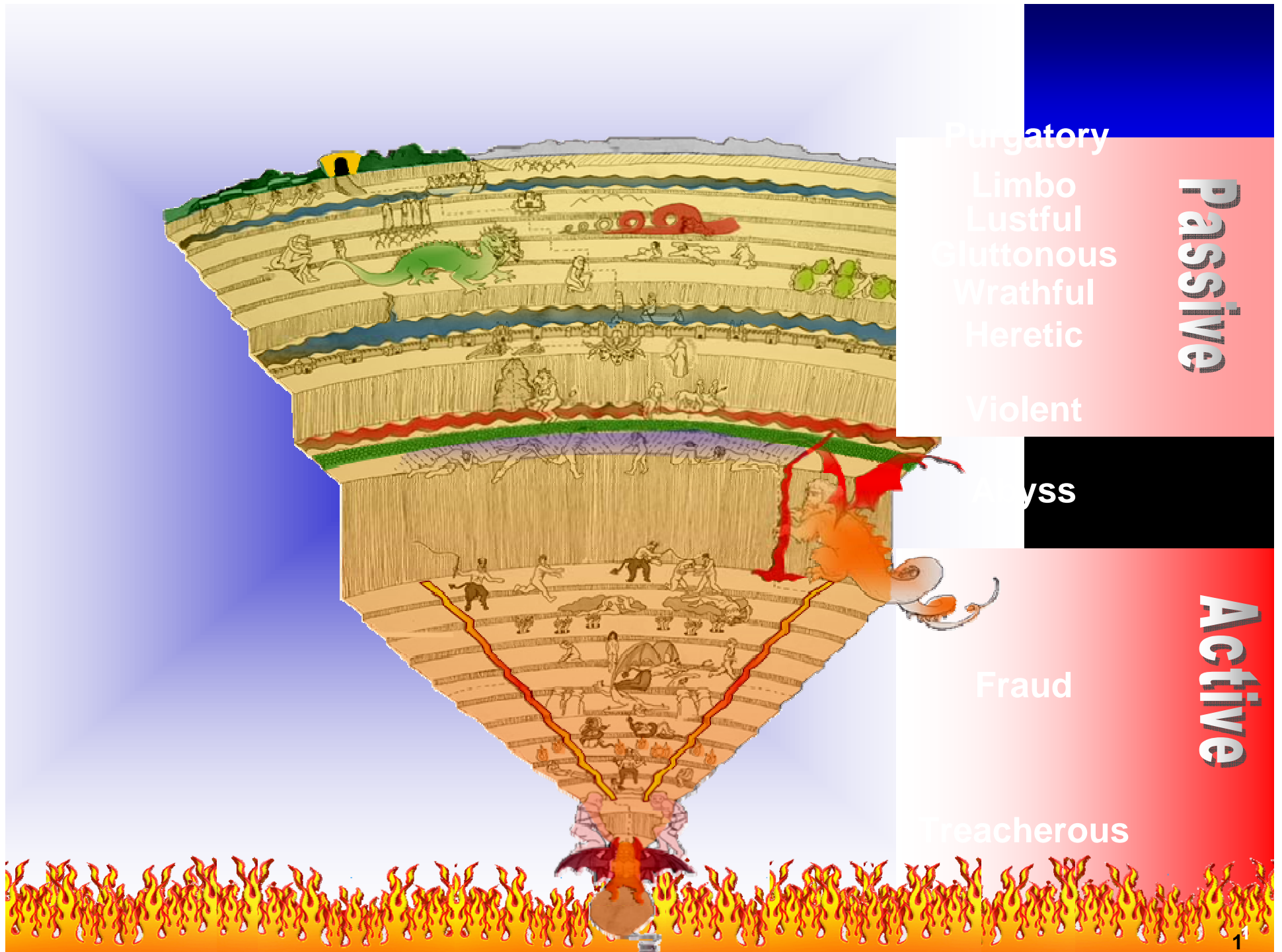


Climate Change
8th Annual Tulane Engineering Forum

J. Wayne Leonard
Chairman and Chief Executive Officer
May 9, 2008





Purgatory

Limbo
Lustful
Gluttonous
Wrathful
Heretic

Violent

Abyss

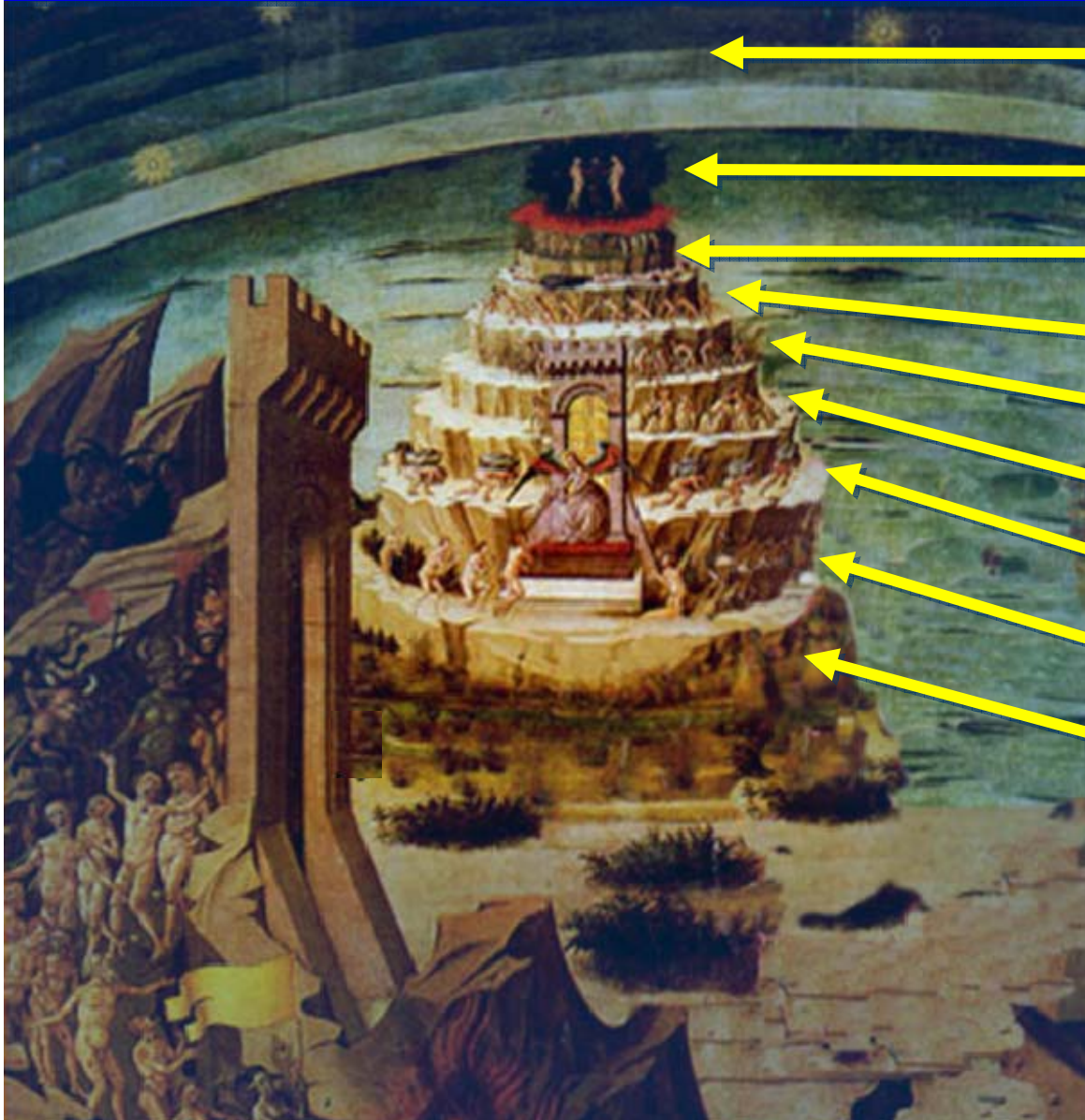
Fraud

Treacherous

Passive

Active

“As I look back on my life, I see it as one long obstacle course with myself as the main obstacle.”
Jack Paar



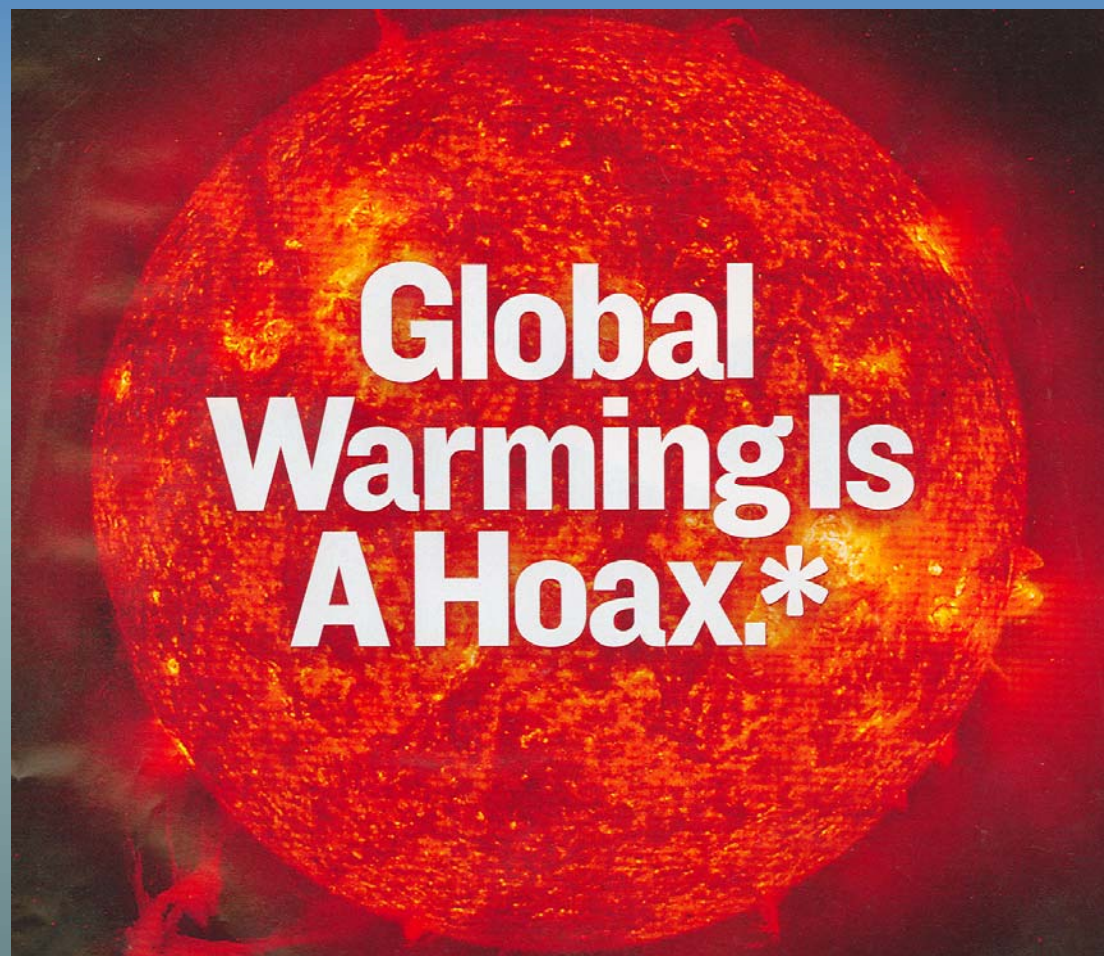
Heaven
Garden of Eden
Lust
Gluttony
Greed
Sloth
Wrath
Envy
Pride

Climate Change... Pride or Prejudice?

Newsweek

* Or so claim well-funded naysayers who will still reject the overwhelming evidence of climate change. Inside the denial machine.

By Sharon Begley.



Cooling? Warming? Which Is It?



Newsweek

April 28, 1975

The Cooling World

There are ominous signs that the earth's weather patterns have begun to change dramatically and that these changes may portend a drastic decline in food production—with serious political implications for just about every nation on earth. The drop in food output could begin quite soon, perhaps only ten years from now. The regions destined to feel its impact are the great wheat-producing lands of Canada and the U.S.S.R. in the north, along with a number of marginally self-sufficient tropical areas—parts of India, Pakistan, Bangladesh, Indochina and Indonesia—where the growing season is dependent upon the rains brought by the monsoon.

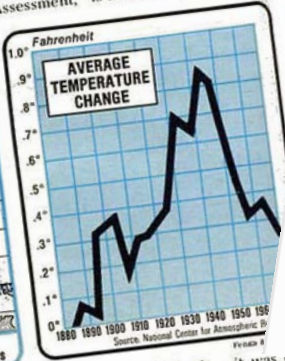
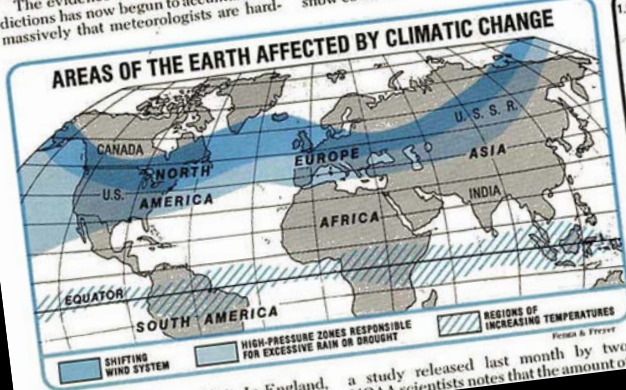
There is evidence in support of these predictions has now begun to accumulate so massively that meteorologists are hard-ly to reduce agricultural productivity for the rest of the century. If the climatic change is as profound as some of the pessimists fear, the resulting famines could be catastrophic. "A major climatic change would force economic and social adjustments on a worldwide scale," warns a recent report by the National Academy of Sciences, "because the global patterns of food production and population that have evolved are implicitly dependent on the climate of the present century."

A survey completed last year by Dr. Murray Mitchell of the National Oceanic and Atmospheric Administration reveals a drop of half a degree in average ground temperatures in the Northern Hemisphere between 1945 and 1968. According to George Kukla of Columbia University, satellite photos indicated a sudden, large increase in Northern Hemisphere snow cover in the winter of 1971-72. And

ic change is at least as fragmentary as our data," concedes the National Academy of Sciences report. "Not only are the basic scientific questions largely unanswered, but in many cases we do not yet know enough to pose the key questions."

Extremes: Meteorologists think that they can forecast the short-term results of the return to the norm of the last century. They begin by noting the slight drop in over-all temperature that produces large numbers of pressure centers in the upper atmosphere. These break up the smooth flow of westerly winds over temperate areas. The stagnant air produced in this way causes an increase in extremes of local weather such as droughts, floods, extended dry spells, long freezes, delayed monsoons and even local temperature increases—all of which have a direct impact on food supplies.

"The world's food-producing system," warns Dr. James D. McQuigg of NOAA's Center for Climatic and Environmental Assessment, "is much more sensitive to



pressed to keep up with it. In England, a study released last month by two NOAA scientists notes that the amount of farmers have seen their growing season

TIME

June 24, 1974

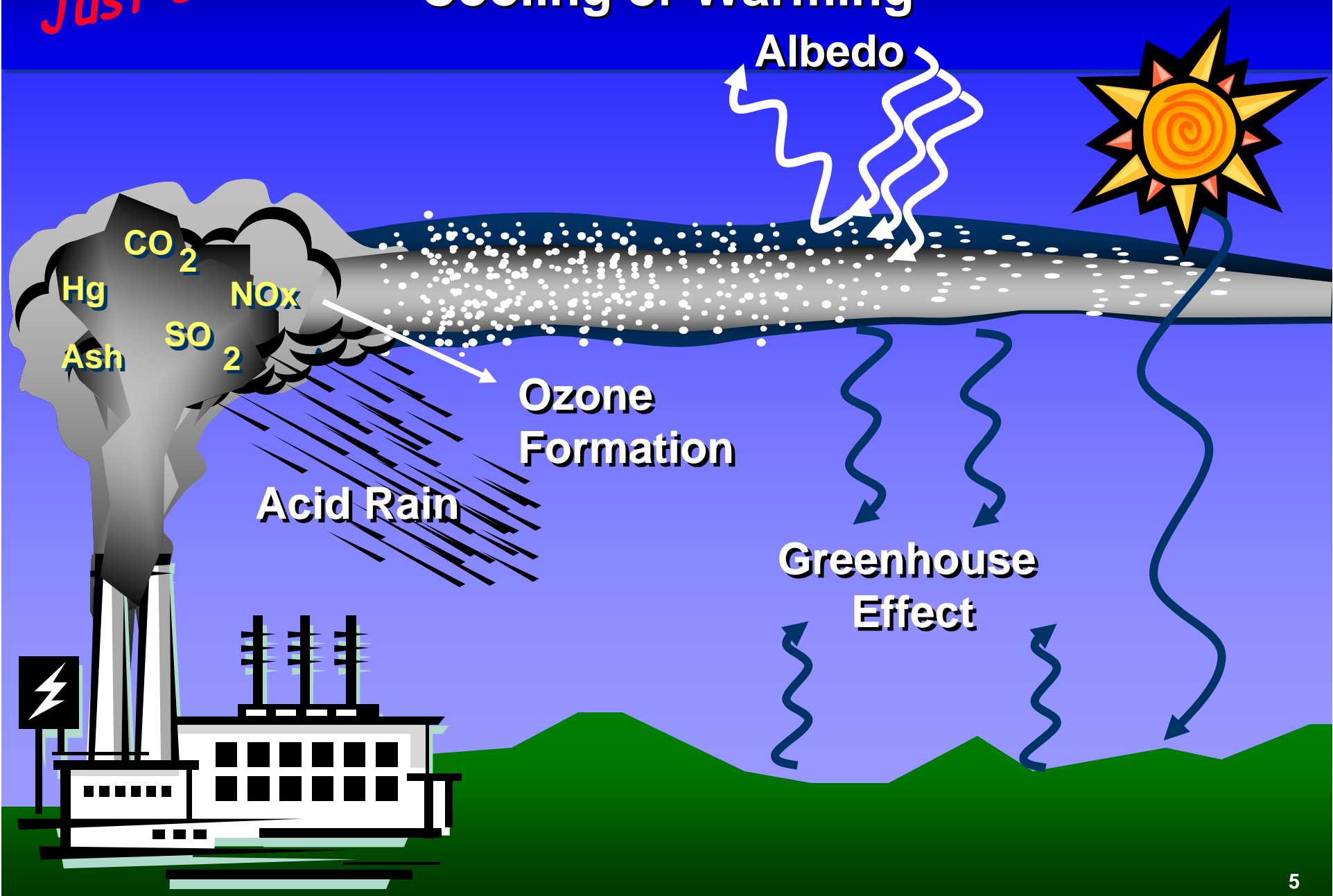


Another Ice Age?

In Africa, drought continues for the sixth consecutive year, adding terribly to the toll of famine victims. During 1972 record rains in parts of the U.S., Pakistan and Japan caused some of the worst flooding in centuries. In Canada's wheat belt, a particularly chilly rainy spring has delayed planting and may well bring a disappointingly small harvest. Rainy Britain, on the other hand, has suffered from uncharacteristic dry spells the past few springs. A series of unusually cold winters has gripped the American Far West while New England and northern Europe have recently experienced the mildest winters within anyone's recollection.

Just Guessing

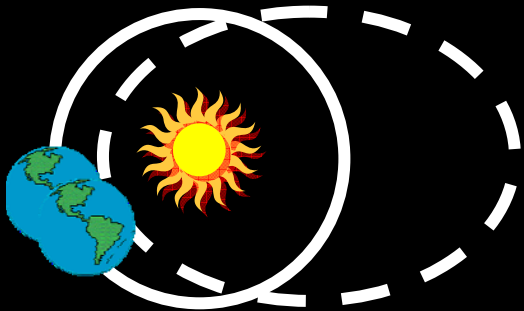
Cooling or Warming



Not a problem

Part of the Natural Forcing Cycle

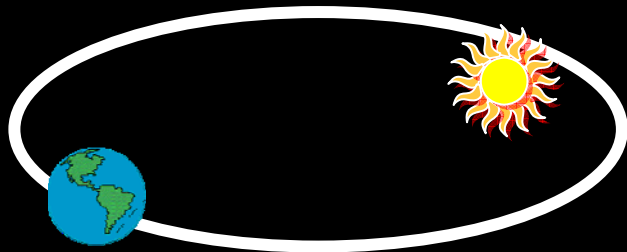
Eccentric Orbital Path



100,000 Year cycle

How Much Radiation

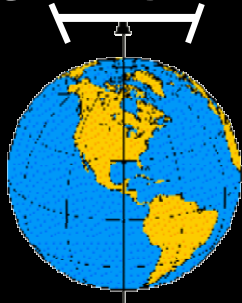
Tilt On Its Axis



41,000 Year cycle

Intensity of Seasons

Wobble On Its Axis

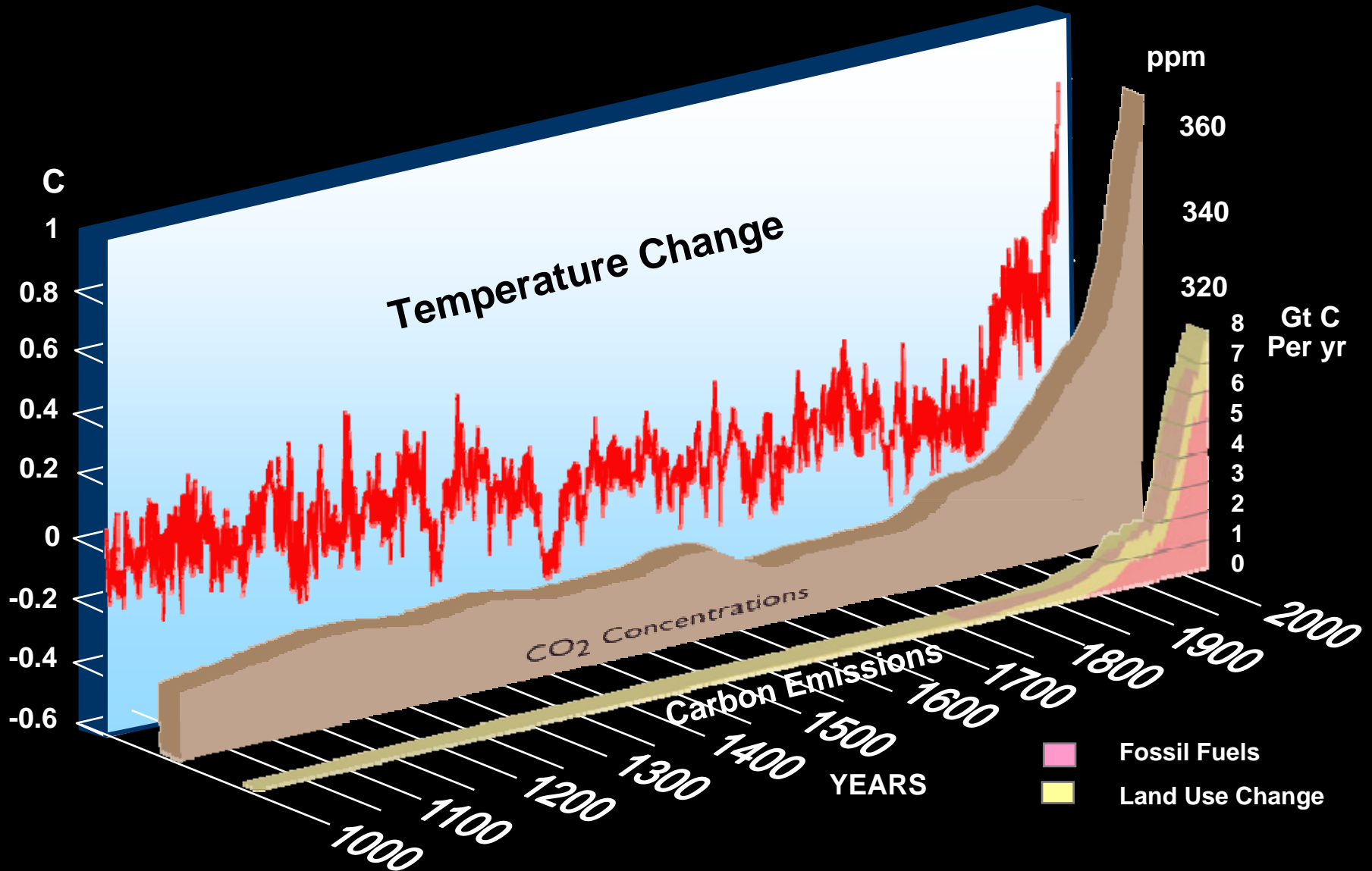


22,000 Year cycle

*Timing/
Seasonal Contrast*

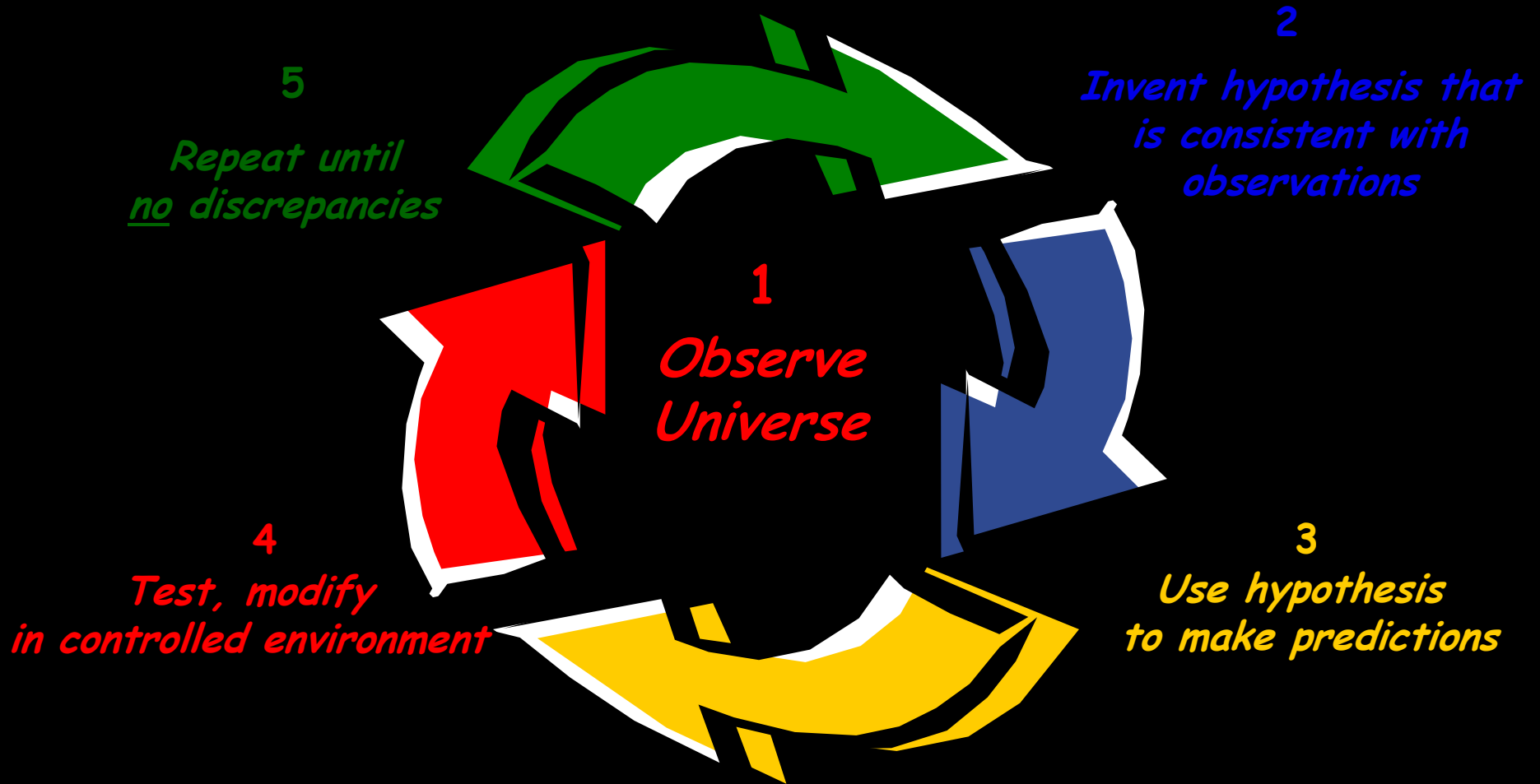
Climate Change?? Prove It.

(Anyone know the difference between correlation and cause & effect?)



The Last Act of God* or **Scientific Theory?**

Scientific Method



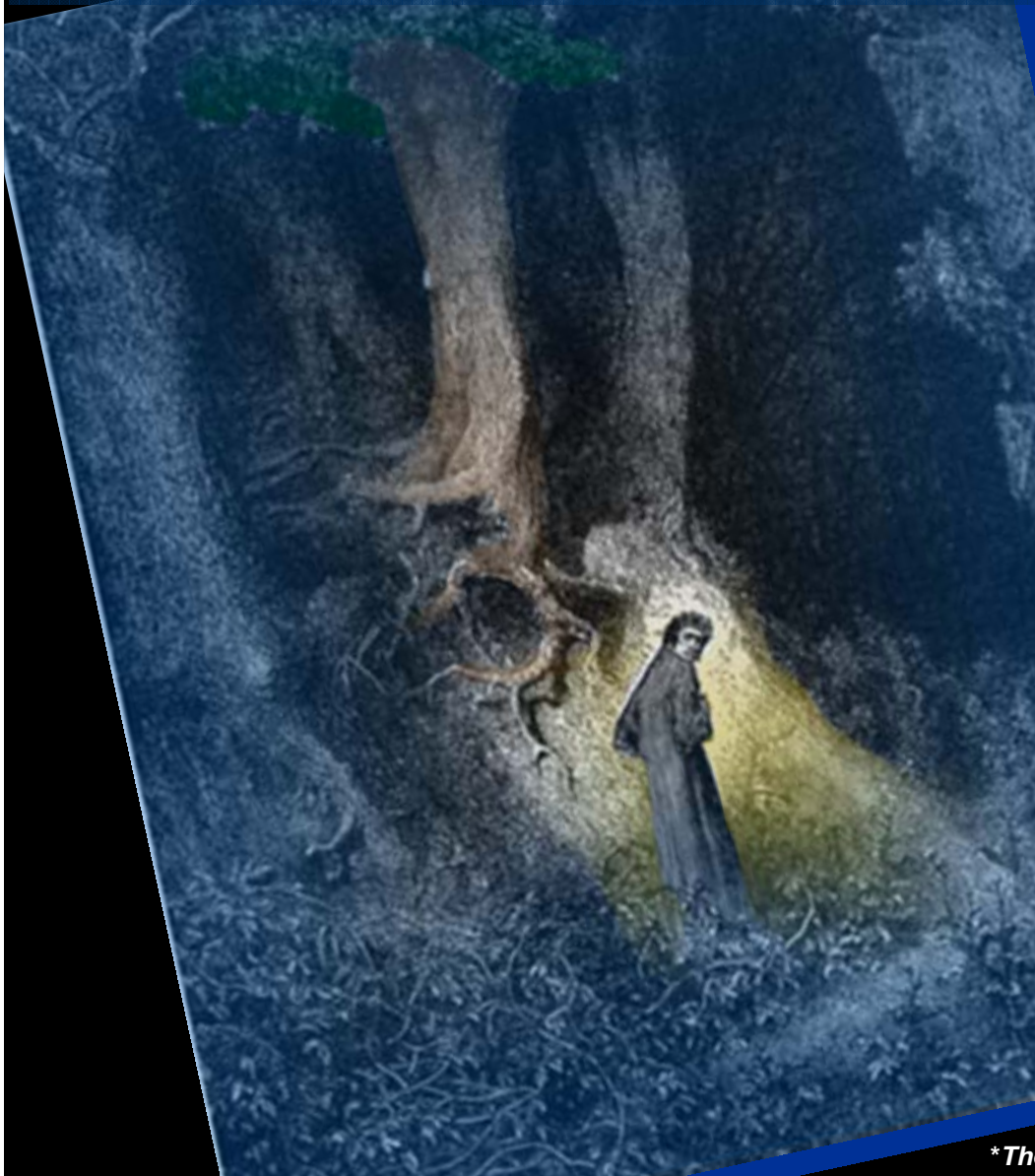
* An Act of God - Something which no reasonable man could have expected
(Sir A.P. Herbert)

Religion or **Science**?

“Because of the inapplicability of the scientific method when dealing with **open** systems,

opinions on global warming are **beliefs** akin to a sort of religious view and not scientific **fact**.”

A False Choice!



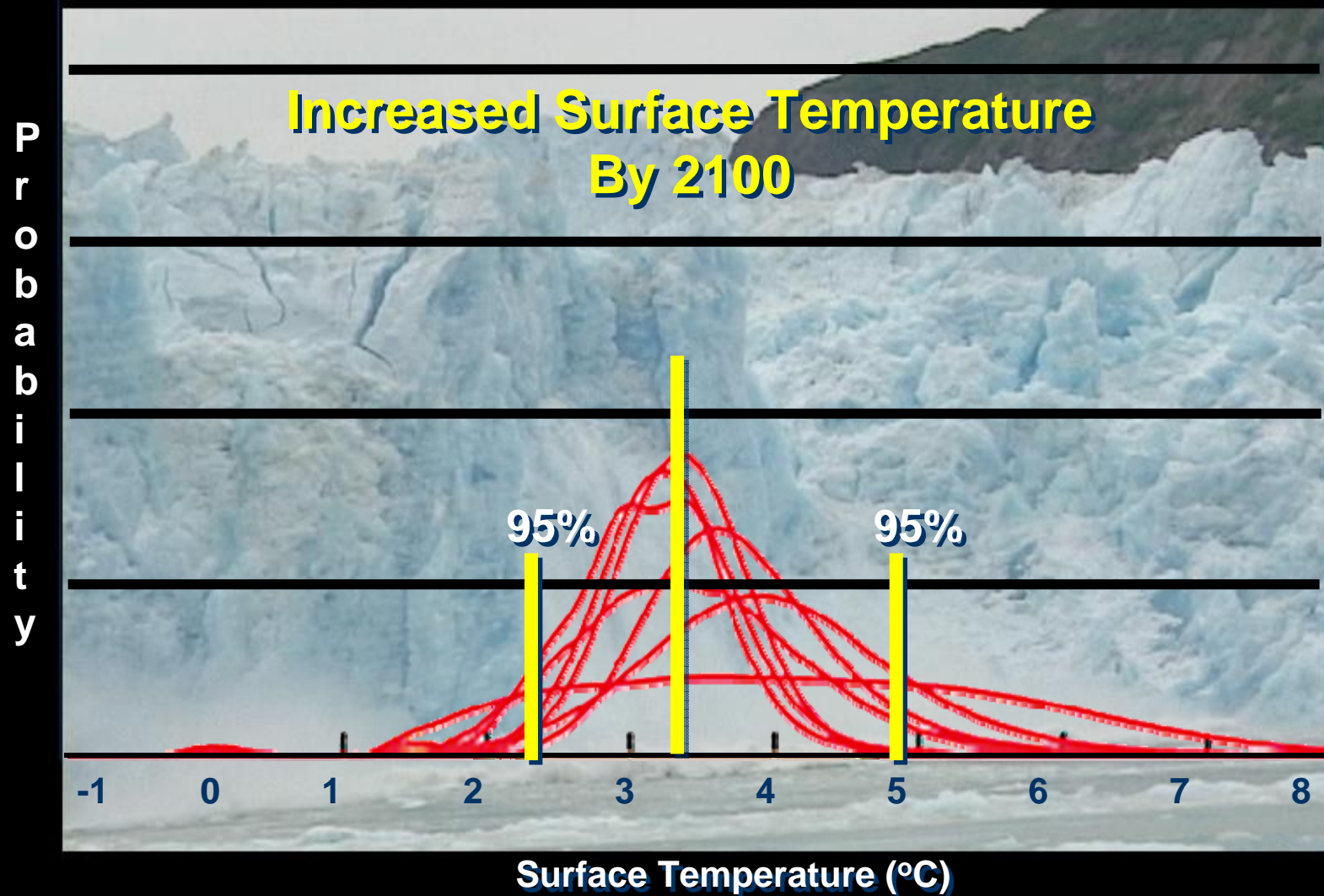
***“Midway upon
the journey of
our life
I found myself
within a forest
dark. For the
straight forward
pathway had
been lost.”***

It's About the Science. Natural? Social?

*If environment is the
Mother of all Public Goods,
then Climate Change is the
Father of all
Decision Making Under Uncertainty*

...Nordhaus

IPCC – The Gold Standard

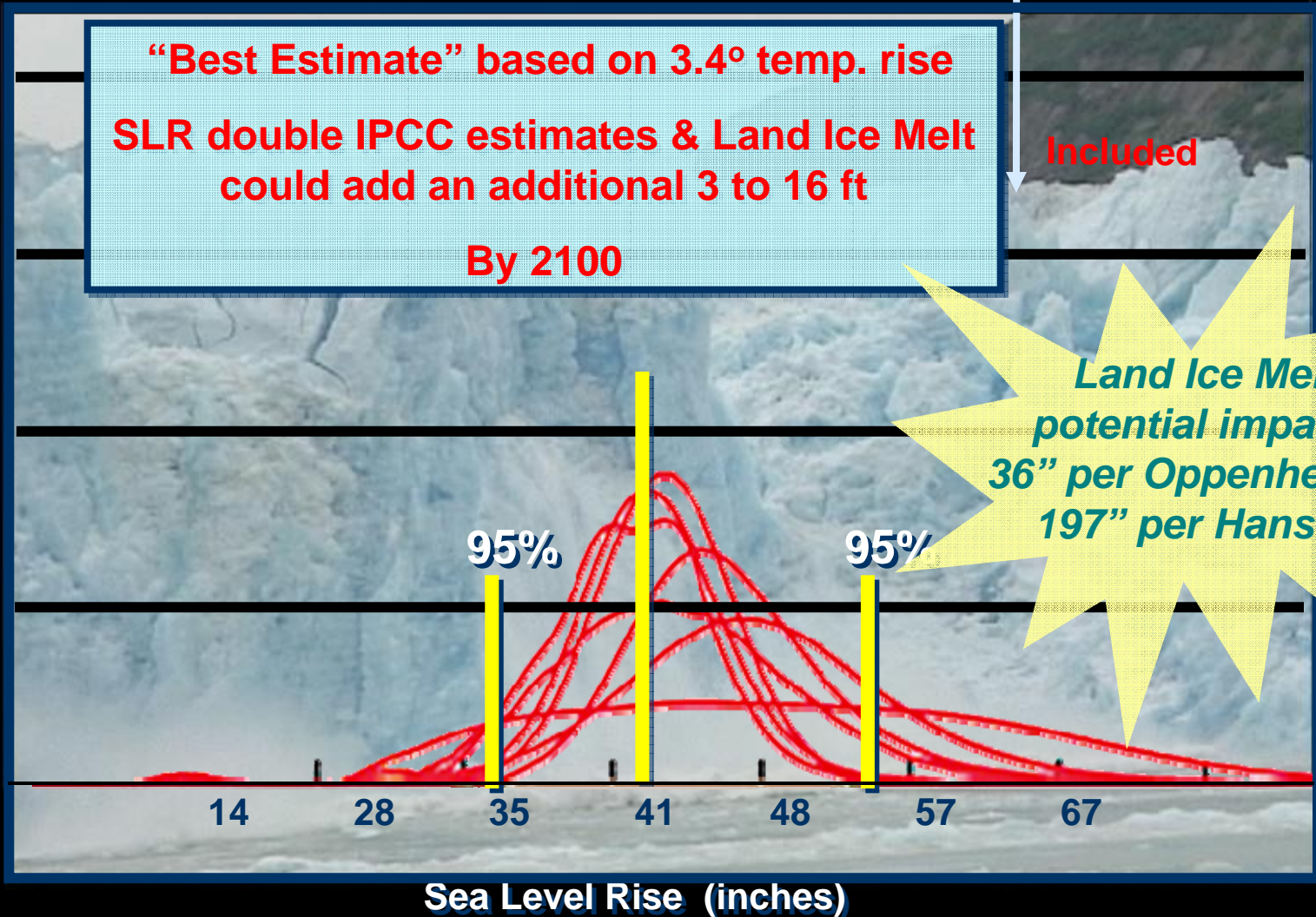


Adapted from Intergovernmental Panel of Climate Change (IPCC) Fourth Assessment Report (AR-4) Fig SPM 5

IPCC – The Gold Standard

Excludes Land Ice Melt

P
r
o
b
a
b
i
l
i
t
y



IPCC AR-4 without land ice melting = 7” to 23” (Third Assessment Report (TAR) 4” to 35” from land ice melt)

Adapted from IPCC AR-4 Fig SPM 5 – Using Rahmstorf Empirical Formula (Rahmstorf, et al 2007)

Sea Level Today vs. 16 Foot Increase Louisiana

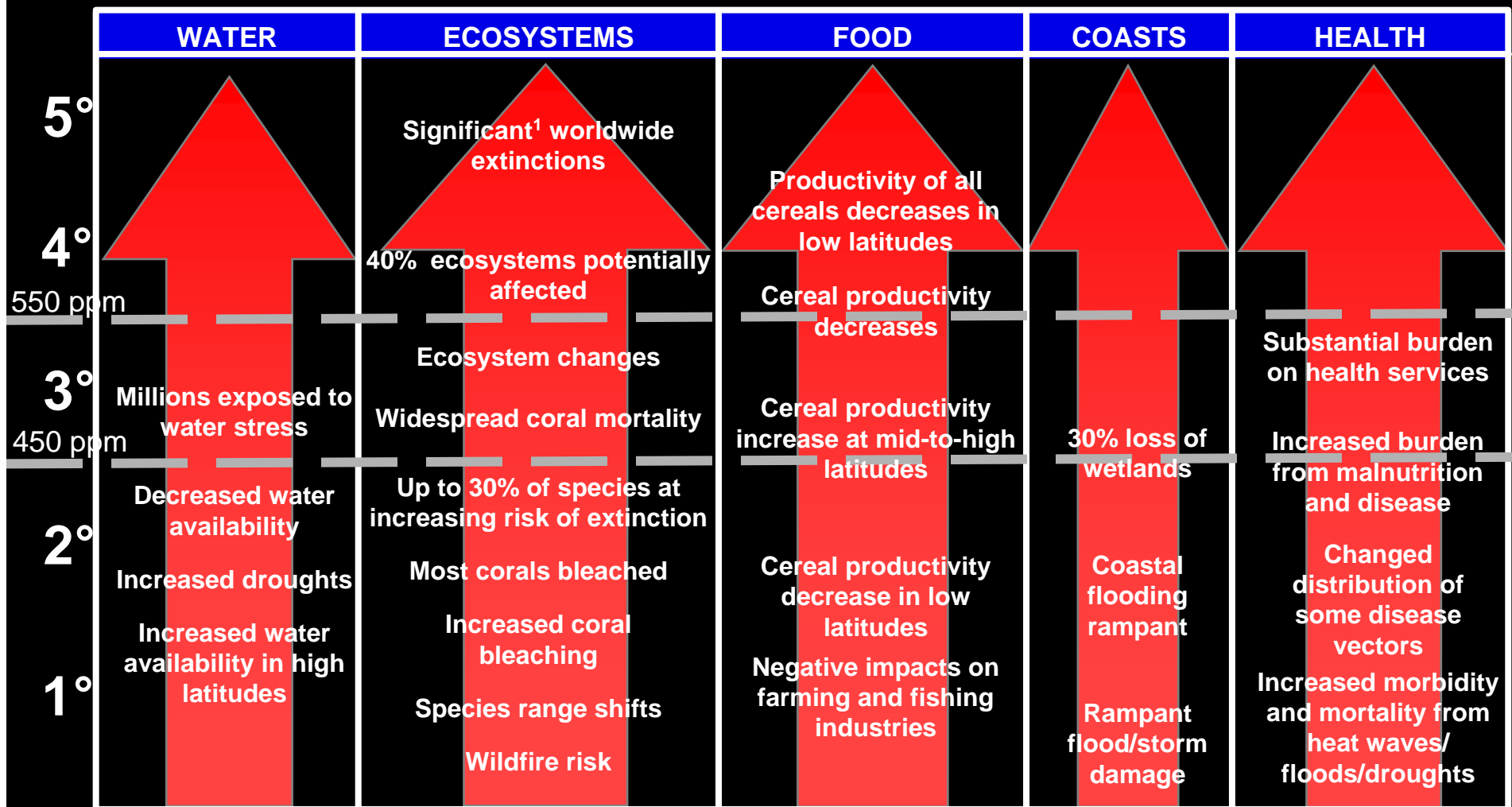


White areas are highly populated areas

Gulf of Mexico

Why 'Climate Change' Is The Issue

Global mean annual temperature change °C (relative to 1980 – 1999)



¹ Significant defined as more than 40%

What Does It Cost

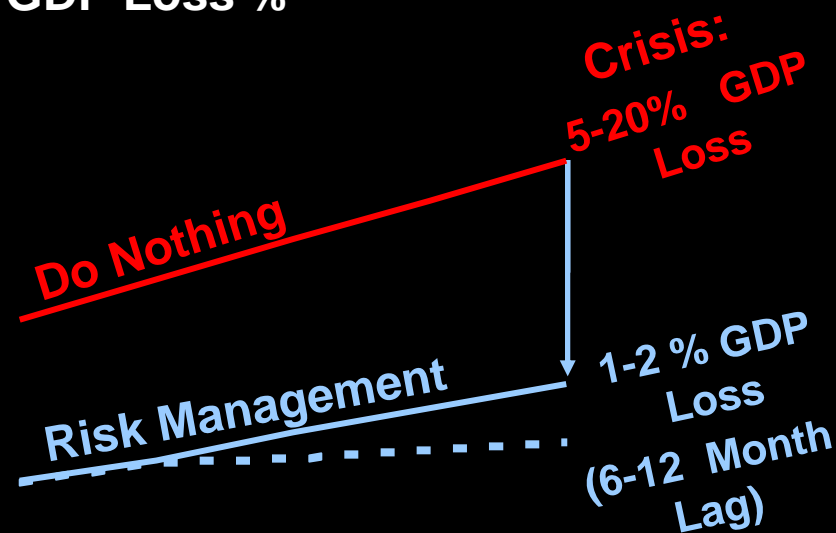
To Do Nothing ?

Cost of Not Dealing With Now:

- Creating a 5° C warmer world by 2100
- Irreversible commitment to sea level rise inundating low lying coastal areas
- Increased coastal flooding impacting up to 30 million people/year
- Increased damage from storms impacting up to 15 million people/year
- Global food shortages as adaptive capacity exceeded in low latitudes and yield decreases in higher latitudes
- Increased burden on health from malnutrition, cardio-respiratory and infectious diseases
- Water scarcity for up to 15 million people
- Catastrophic events

Illustrative

GDP Loss %



What is the cost of doing nothing?

The Economists

Half
Empty!

Half
Full!

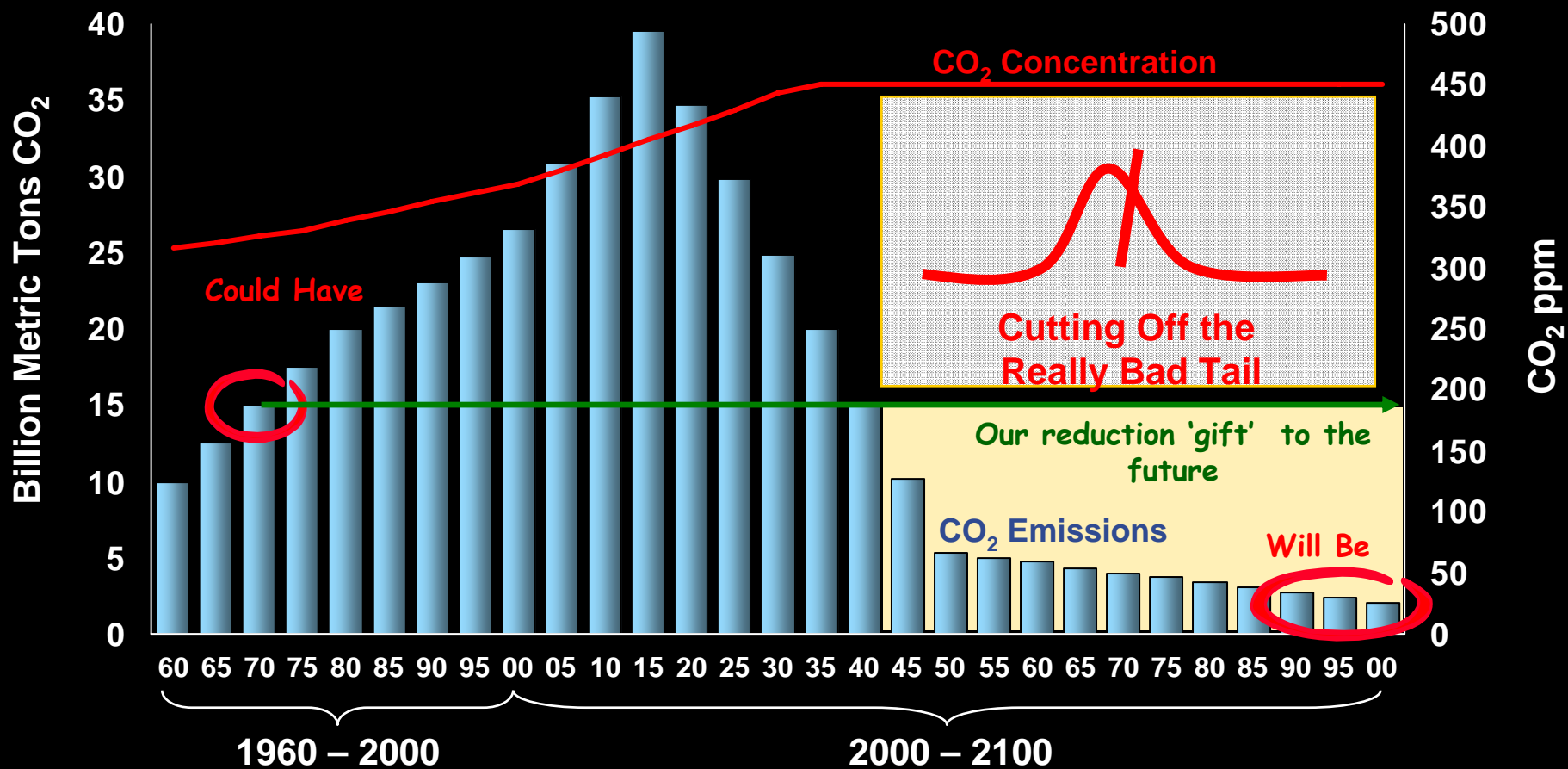


Limited Choice

Do No Harm

Global Pathway to Stabilize at 450 ppm CO₂ eq –
Equivalent to Capping Emissions Back in 1970

Illustrative



“You can always count on Americans to do the right thing – after they have exhausted all other possibilities.”

--Winston Churchill



That's What We Need, A Brilliant Idea.



Drilling a Hole May Help





It's Just '*Goofy*' to Do Nothing

*Net savings world-wide
by stabilizing
(GHG = \$1-2 Quadrillion)*



It's Just **'Goofy'** to Give Free Allowances to Generators



Generators Strike Gold (Recover Twice)

It's Just 'Goofy' to Mandate a Technology vs. to Let the Market Work

Economic Loss

Using RPS vs. Other

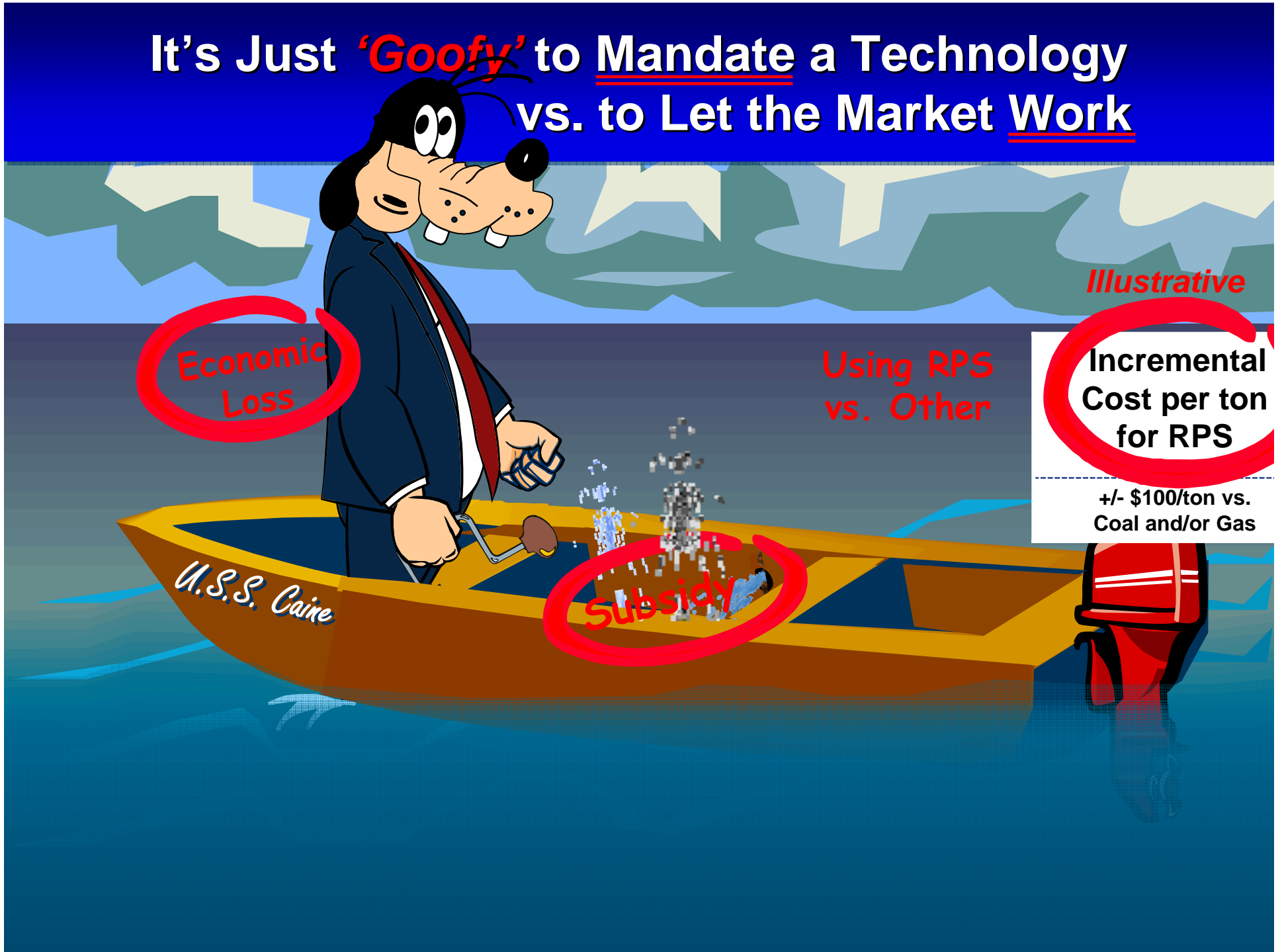
Illustrative

Incremental Cost per ton for RPS

+/- \$100/ton vs. Coal and/or Gas

subsidy

U.S.S. Caine



It's Just 'Goofy' to Set a Safety Value **So** Low
Fails to Change Behavior

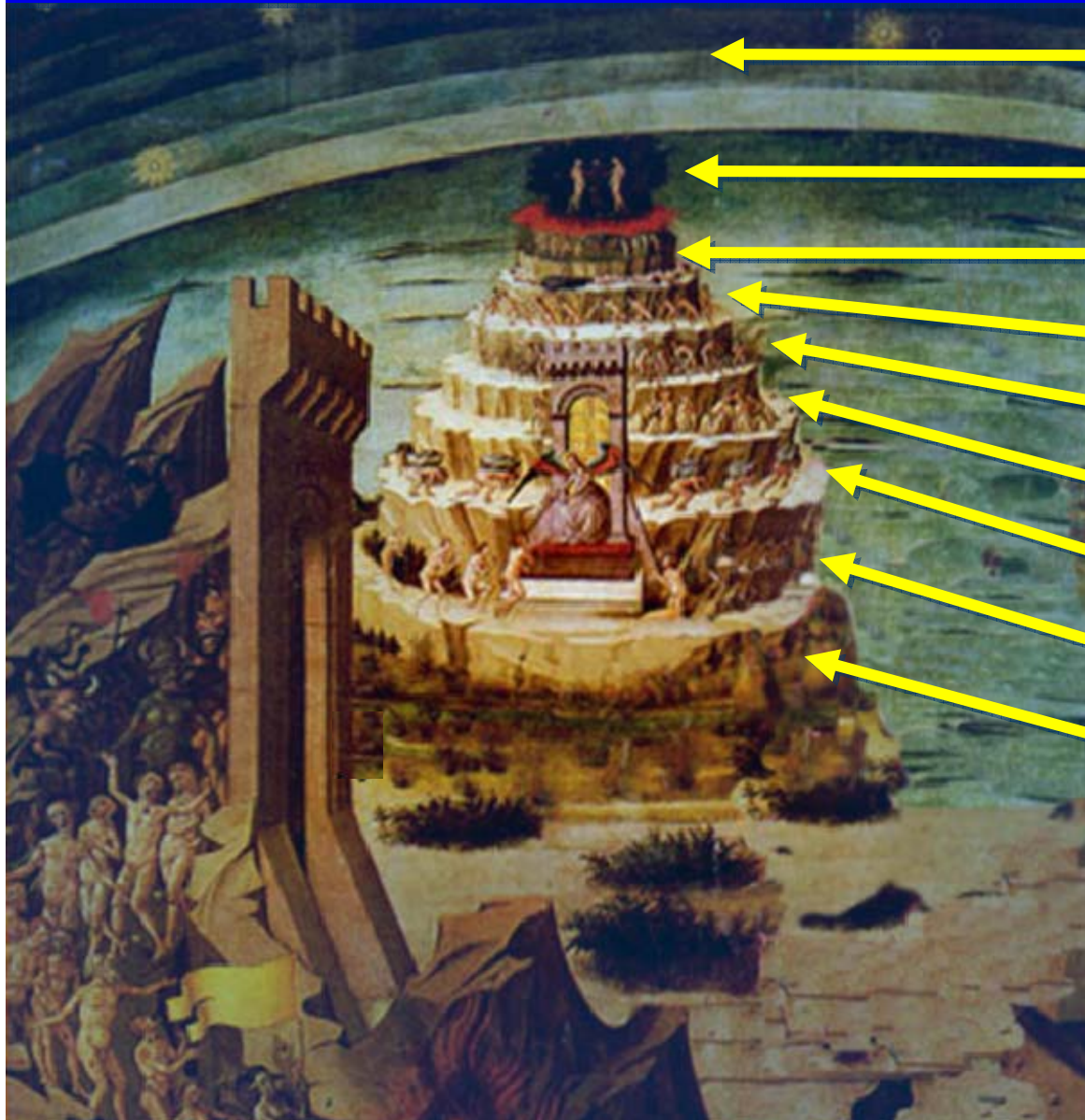


"Lasciate ogni speranza, voi ch'intrate."



The Divine Comedy
By Dante Alighieri

“As I look back on my life, I see it as one long obstacle course with myself as the main obstacle.”
Jack Paar

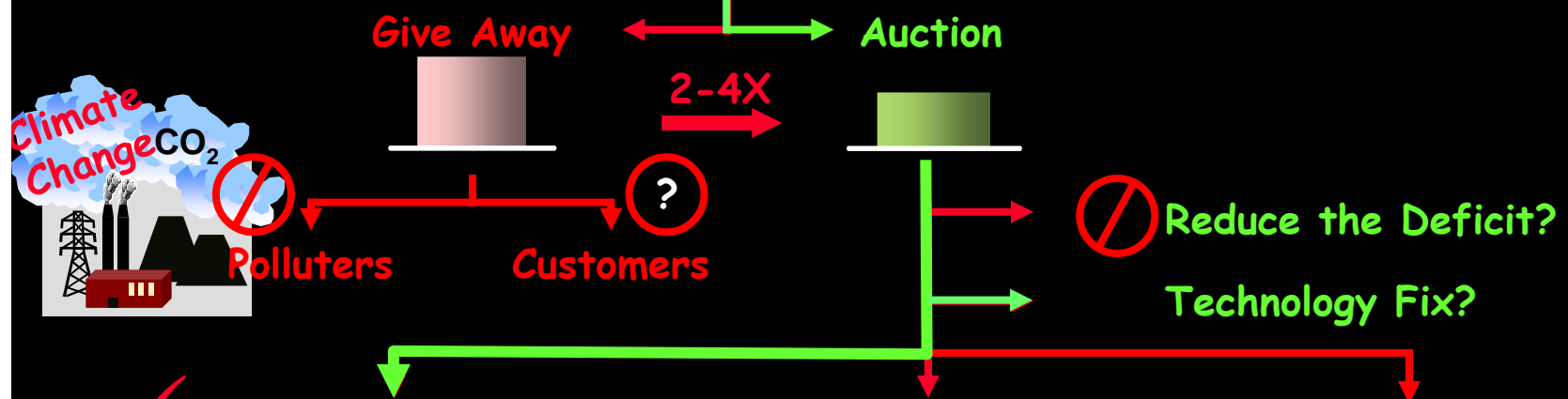


Heaven
Garden of Eden
Lust
Gluttony
Greed
Sloth
Wrath
Envy
Pride

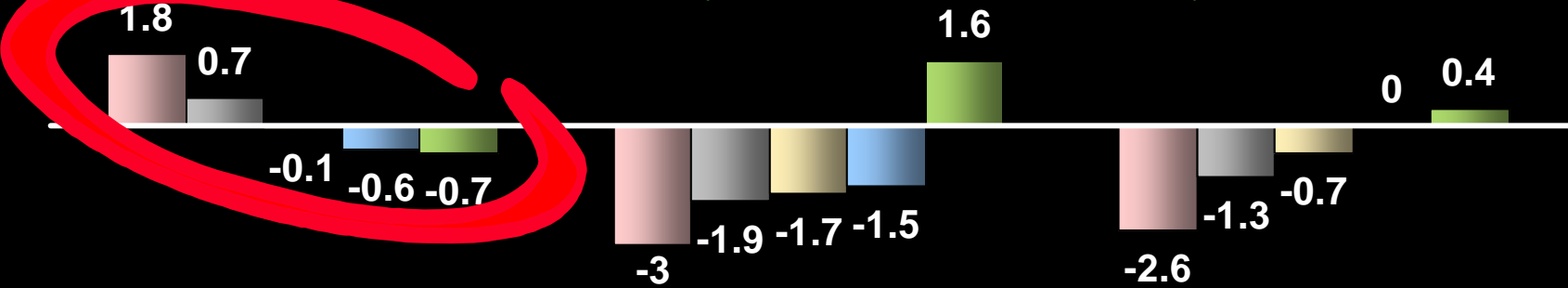
Hail Mary



Carbon Tax Or **Cap and Trade**
Fix Price ~~⊘~~ **Fix Emissions**



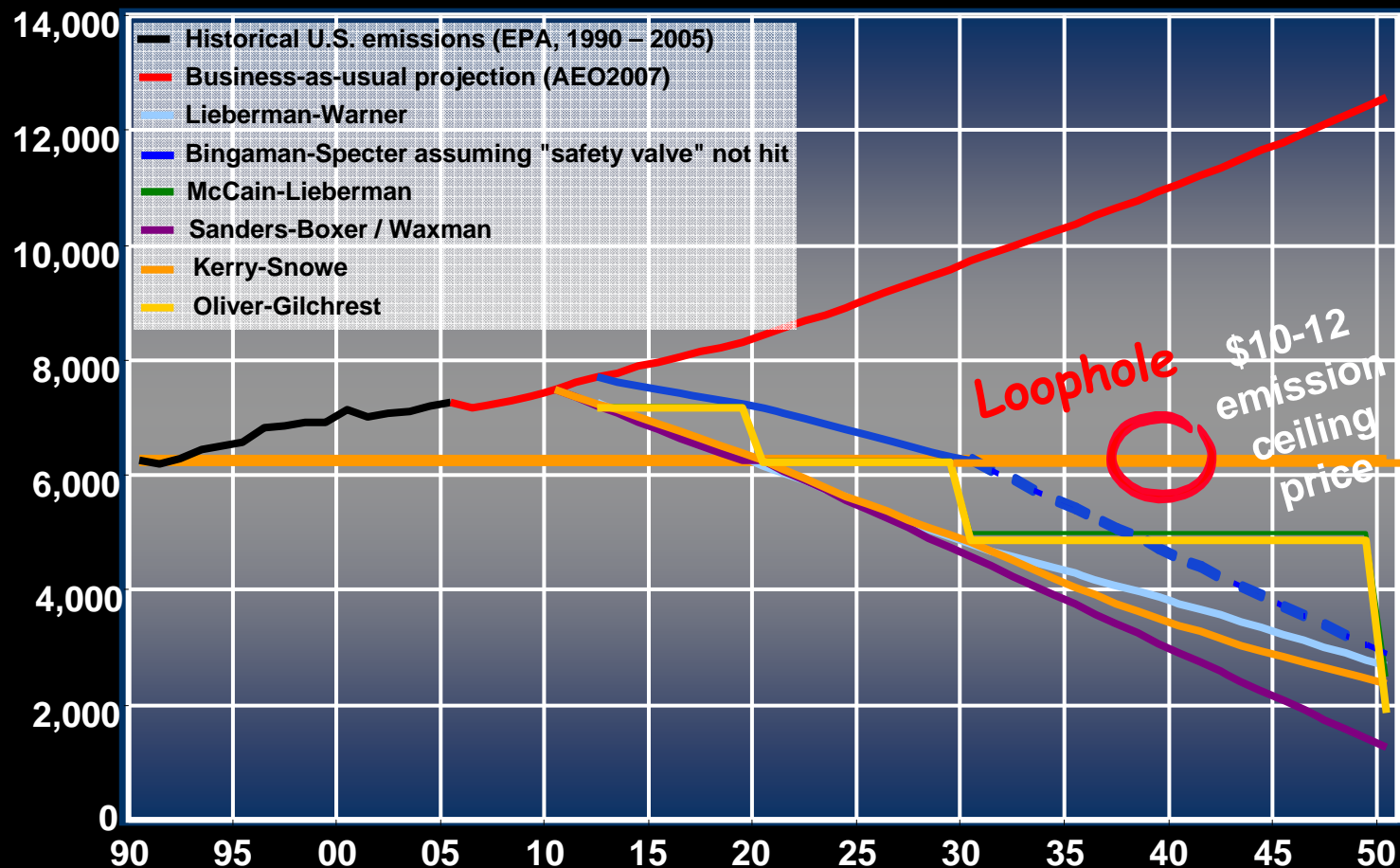
✓ **Used to Provide Equal Lump-Sum Household Rebates**
 Used to Cut Corporate Taxes
 Used to Cut Payroll Taxes



Effect on Average After-Tax Household Income, by Income Quintile
 Revenue from Allowance Sales for a 15% Cut in CO₂ in 2010

Proposed Climate Legislation (110th Congress)

Emissions 1990 – 2050; MMt CO₂e



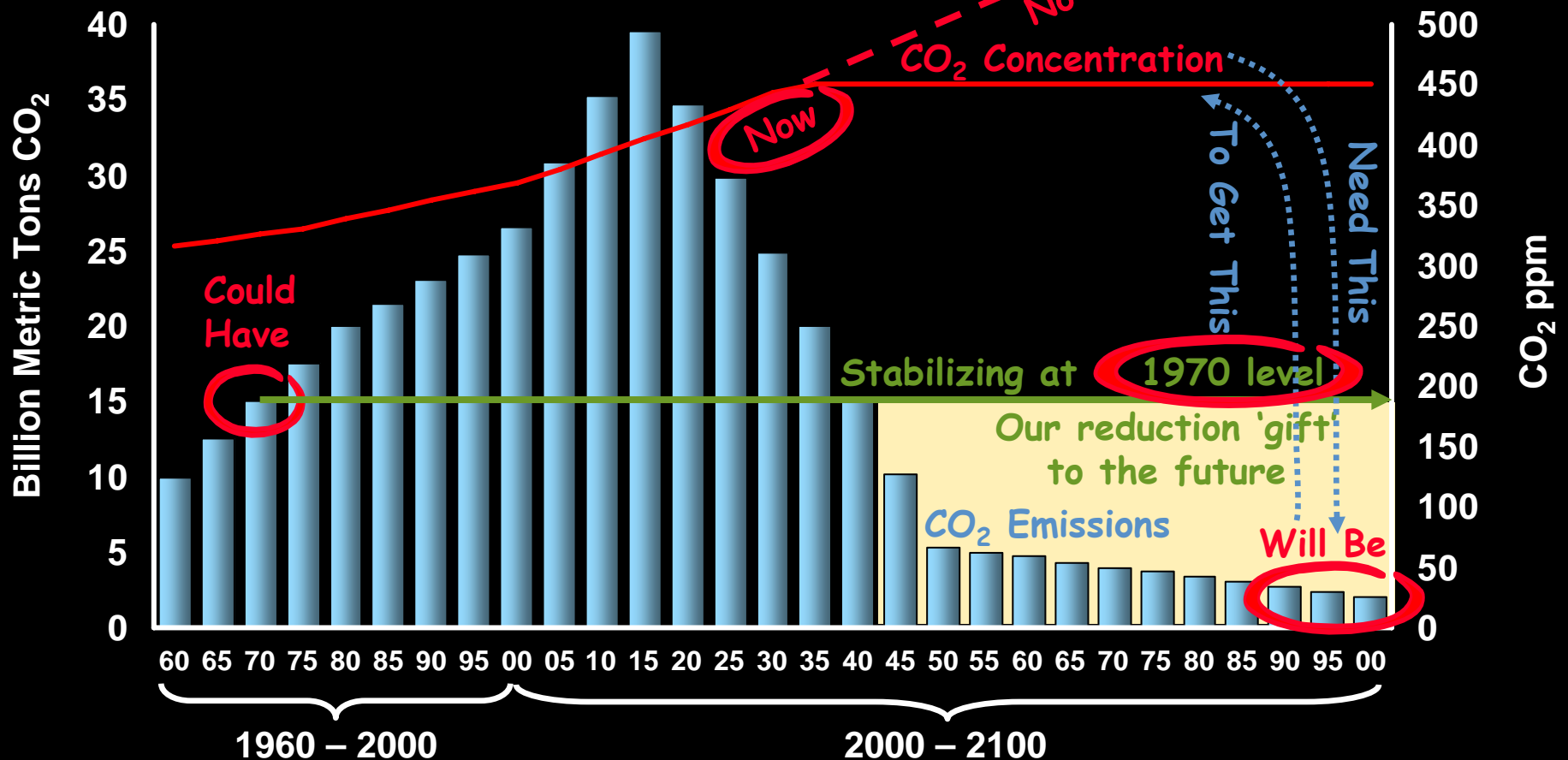
Bingaman-Specter assumes multiple low-carbon policies, including: car & light truck fuel economy of 41 mpg by 2027; Federal RPS of 15% by 2020; and optimistic assumptions about new technologies coming online. Under these policies, the safety valve is not triggered. Without these policies the safety valve is expected to be reached in the early years and the target will be exceeded. The target remains at 2030 levels unless the President sets additional long-term targets.

“All the time you spend tryin’ to get back what’s been took from you there’s more goin’ out the door. After a while you just try and get a tourniquet on it.”*

-- ELLIS, No Country for Old Men

Climate Change

Global Pathway to Stabilize at 450 ppm CO₂ eq – Equivalent to Capping Emissions Back in 1970

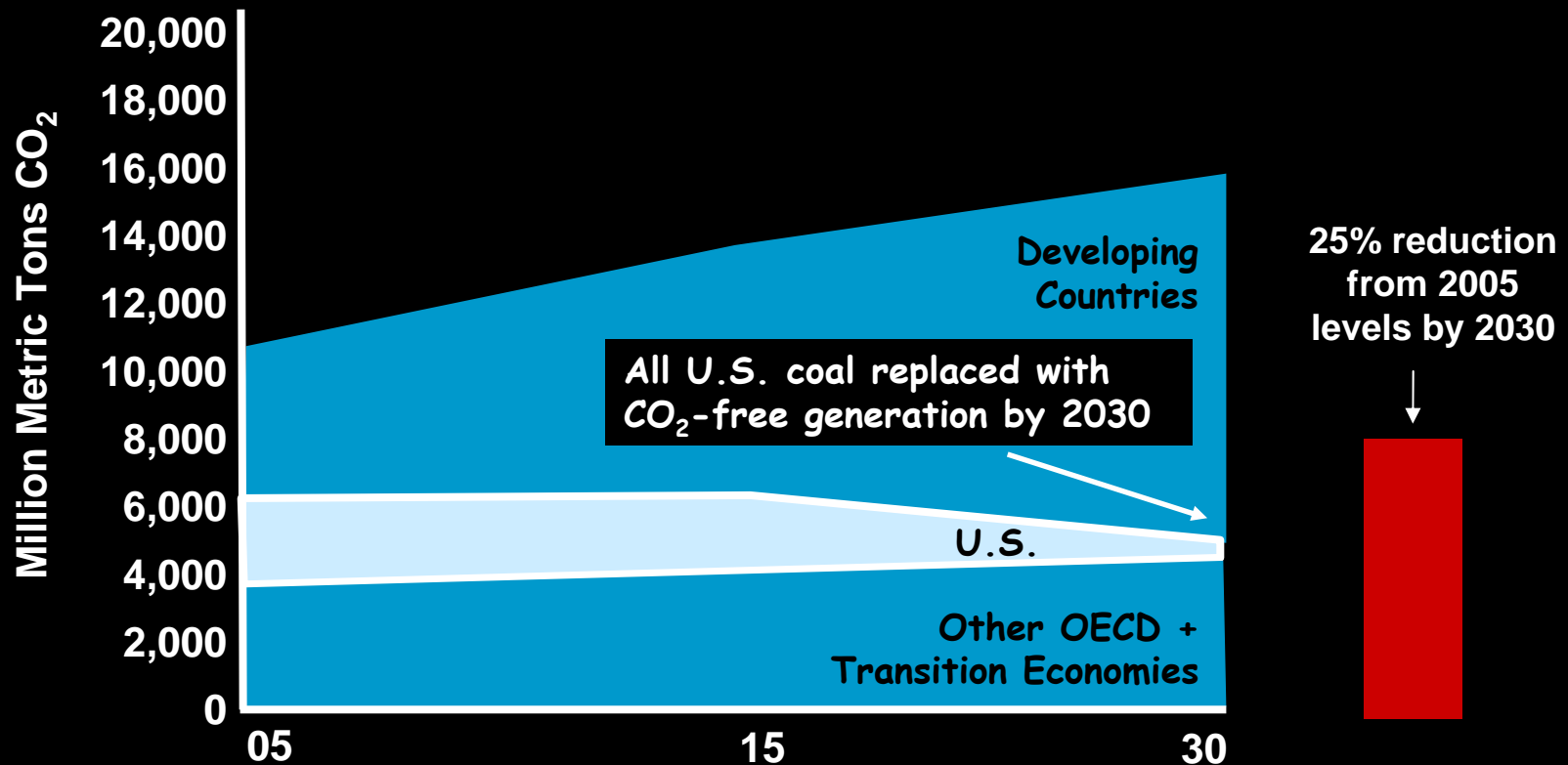


*No Country for Old Men - Joel Coen & Ethan Coen - 2007, Paramount Vantage.

“There just ain’t no way.”*

-- MOSS, No Country for Old Men

**Global Electric Sector CO₂ Forecast
2005 - 2030 (With All U.S. Coal Shut Down by 2030)**

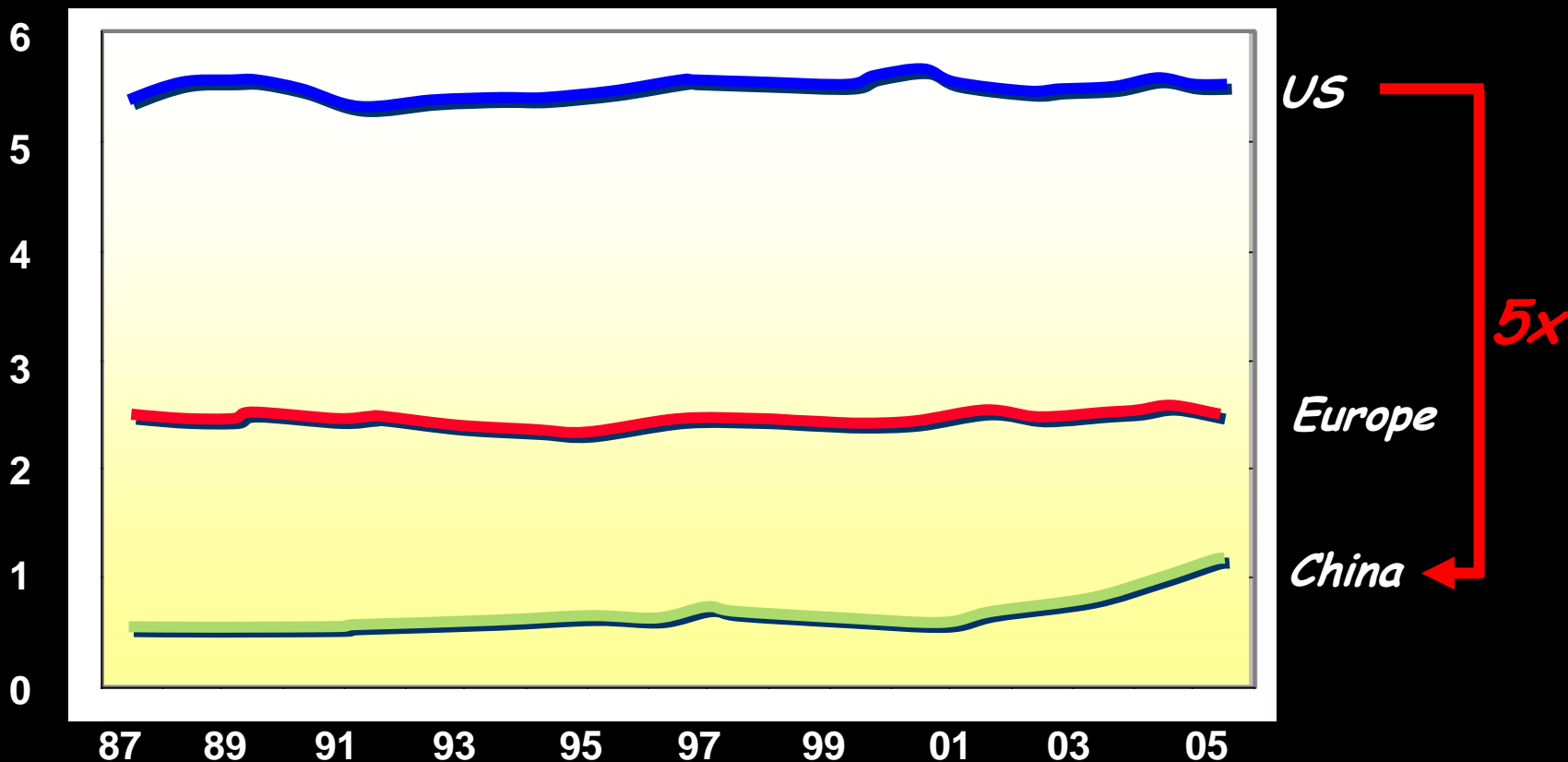


✓ Shutting all coal plants in the United States by 2030 won't achieve global target without cutting into coal emissions in the developing countries

✓ Technology to retrofit conventional coal plants for capture and sequestration must be part of the solution

“...that’s aggravating.”* -- WENDELL
“I’m ahead of you there.”* -- BELL
No Country for Old Men

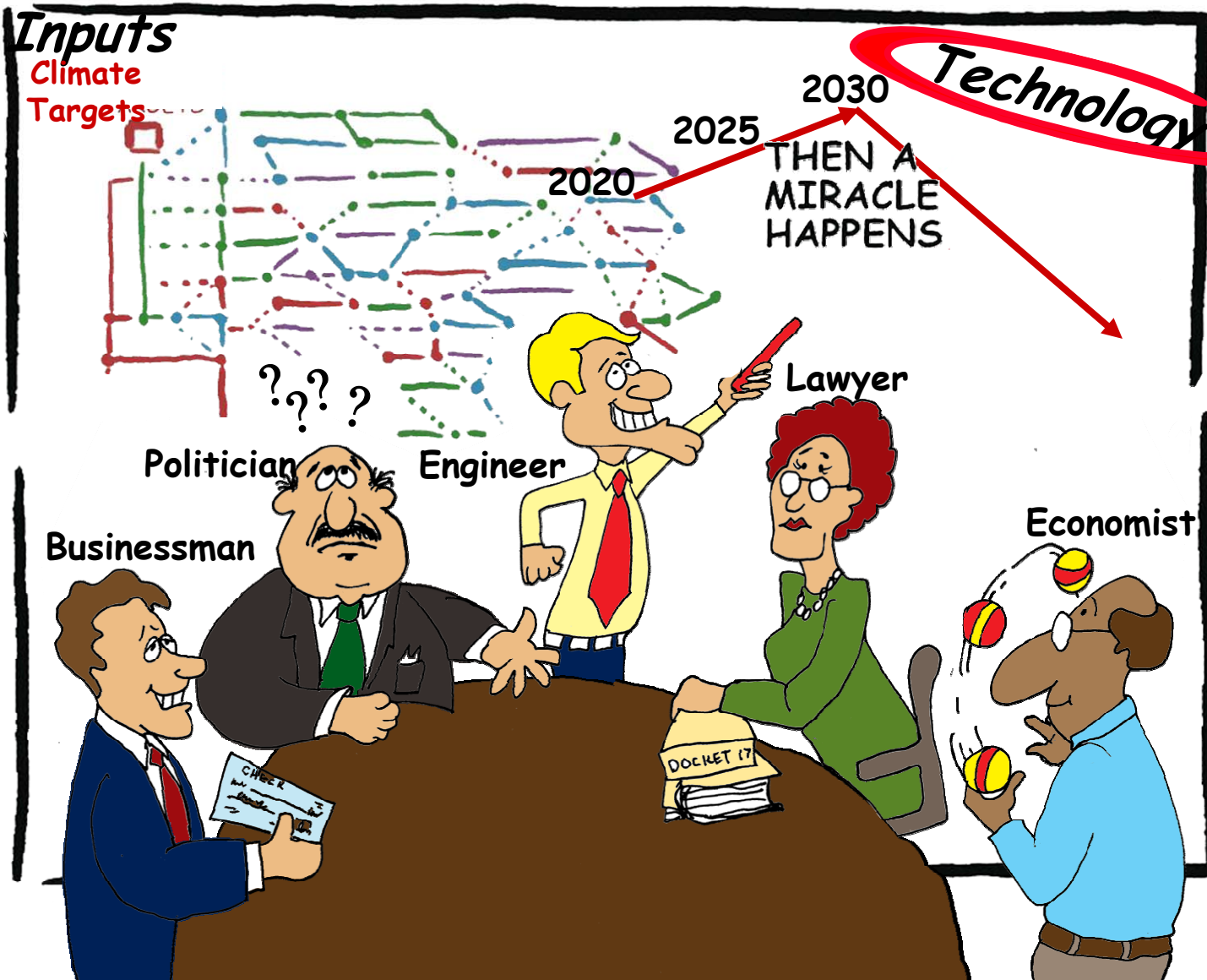
Tons of Carbon Equivalent Per Person 1987 – 2005



Source U.S. Energy Information Administration 2007

*No Country for Old Men - Joel Coen & Ethan Coen - 2007, Paramount Vantage.

Who Gets the Ball with the Time Running Out?



R-E-S-P-E-C-T

(Or Return of the Age of Technology)

Engineering's Role in Developing Climate Change Solutions

Petroleum

- ✓ Uncover new oil & gas locations
- ✓ New tools to extract oil & gas
- ✓ Long-term security of underground gas storage

Transportation

- ✓ High speed mass transit foundation
- ✓ Congestion reduction

Aero-space

- ✓ Systems & fuel efficiency

Agri-cultural

- ✓ Alternative fuels

Chemical

- ✓ CO₂ capture
- ✓ Alternative fuels
- ✓ Processing of liquids & gases

Civil

- ✓ Construction (ease, environ. adaptive, etc.)
- ✓ Levees/dikes for current & future coastal conditions
- ✓ Land use expansion
- ✓ New tools to extract oil & gas
- ✓ High speed mass transit foundation

Nuclear

- ✓ Advanced fuel cycle (beyond uranium)
- ✓ Advanced reactors & control systems design

Computer

- ✓ Systems efficiency

Mechanical

- ✓ Energy efficient production in machines/devices, motors/engines, air conditioning, conversion of electricity, etc.
- ✓ New tools to extract oil & gas

Electrical

- ✓ Power generation & distribution
- ✓ Smart grid; advanced meter interface
- ✓ Superconducting cable & other devices

Materials

- ✓ Solar PV panels efficiency (operations & manufacturing)

Geo-logical

- ✓ Long-term security of underground gas storage

Environmental

- ✓ Wetlands protection & regeneration
- ✓ Miss. River delta; diversion
- ✓ Pollution reduction
- ✓ Recycling
- ✓ Renewable power integration
- ✓ Plug-in hybrid vehicles

**NO COUNTRY
FOR OLD MEN**

No Country for Old Men

ELLIS

**“...What you got ain’t
nothin’ new. This
country is hard on
people. Hard and
crazy...”**

No Country for Old Men

ELLIS

**“You can’t stop what’s
comin. Ain’t all waitin’
on you... That’s vanity.”**

No Country for Old Men

BELL

“Not the one thing. I used to think I could at least some way put things right. I don’t feel that way no more.”

No Country for Old Men

CHIGURH
“You know how this is
going to turn out, don’t
you?”

“A man would have to put his soul at hazard...He would have to say, okay, I’ll be part of this world...”*
-- BELL, No Country for Old Men



There Are No Clean Getaways

No Country for Old Men

CHIGURH

...What's the most you've ever lost on a coin toss?

PROPRIETOR

I don't know. I couldn't say.

CHIGURH – flipping coin

Call it.

PROPRIETOR

I didn't put nothin up.

CHIGURH

Yes you did. **You been putting it up your whole life.** Call it.

PROPRIETOR

Look... I got to know what I stand to win.

CHIGURH

Everything. You stand to win everything.
Call it.

No Country for Old men

"And then I woke up."

No Country for Old Men - Joel Coen &
Ethan Coen - 2007, Paramount Vantage,
unless otherwise indicated.

Climate Change
8th Annual Tulane Engineering Forum

J. Wayne Leonard
Chairman and Chief Executive Officer
May 9, 2008

