Climate Change
8th Annual Tulane Engineering Forum

J. Wayne Leonard
Chairman and Chief Executive Officer
May 9, 2008
"As I look back on my life, I see it as one long obstacle course with myself as the main obstacle."  

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

By Sharon Begley.
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 that have Spells. 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.
Greenhouse Effect

Ozone Formation

Albedo

Acid Rain

Greenhouse Effect

Cooling or Warming

Just Guessing
Part of the Natural Forcing Cycle

Eccentric Orbital Path

- 100,000 Year cycle

Tilt On Its Axis

- 41,000 Year cycle

Wobble On Its Axis

- 22,000 Year cycle

Not a problem
Climate Change?? Prove It.
(Anyone know the difference between correlation and cause & effect?)
The Last Act of God* or Scientific Theory?

Scientific Method

1. Observe Universe
2. Test, modify in controlled environment
3. Use hypothesis to make predictions
4. Invent hypothesis that is consistent with observations
5. Repeat until no discrepancies

* 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!

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

*The Divine Comedy, Inferno, Canto I. Dante Alighieri.*
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

Increased Surface Temperature By 2100

Surface Temperature (°C)

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

“Best Estimate” based on 3.4° temp. rise
SLR double IPCC estimates & Land Ice Melt could add an additional 3 to 16 ft
By 2100

Sea Level Rise (inches)

95% 95%

14 28 35 41 48 57 67

Excludes Land Ice Melt
Included

Land Ice Melt potential impact:
36” per Oppenheimer
197” per Hansen

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

WATER
- Millions exposed to water stress
- Decreased water availability
- Increased droughts
- Increased water availability in high latitudes

ECOSYSTEMS
- Significant\(^1\) worldwide extinctions
- 40% ecosystems potentially affected
- Ecosystem changes
- Widespread coral mortality
- Up to 30% of species at increasing risk of extinction
- Most corals bleached
- Increased coral bleaching
- Species range shifts
- Wildfire risk

FOOD
- Productivity of all cereals decreases in low latitudes
- Cereal productivity decreases
- Cereal productivity increase at mid-to-high latitudes
- Cereal productivity decrease in low latitudes
- Negative impacts on farming and fishing industries

COASTS
- 30% loss of wetlands
- Coastal flooding rampant
- Rampant flood/storm damage

HEALTH
- Substantial burden on health services
- Increased burden from malnutrition and disease
- Changed distribution of some disease vectors
- Increased morbidity and mortality from heat waves/floods/droughts

\(^1\) Significant defined as more than 40%
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
The Economists

Half Empty!

Half Full!
Global Pathway to Stabilize at 450 ppm CO$_2$ eq – Equivalent to Capping Emissions Back in 1970

Illustrative

Our reduction ‘gift’ to the future

Cutting Off the Really Bad Tail

Could Have

Will Be

Limited Choice

Do No Harm
“You can always count on Americans to do the right thing – after they have exhausted all other possibilities.”

--Winston Churchill
U.S.S. Kiwi
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 +/-$100/ton vs. Coal and/or Gas

Incremental Cost per ton for RPS

Using RPS vs. Other

U.S.S. Caine

Illustrative

Subsidy
It’s Just ‘Goofy’ to Set a Safety Value So Low Fails to Change Behavior
"Lasciate ogne speranza, voi ch'intrate."
“As I look back on my life, I see it as one long obstacle course with myself as the main obstacle.”

Jack Paar
Climate Change CO2

Hail Mary

Effect on Average After-Tax Household Income, by Income Quintile

Source: Congressional Budget Office
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

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

“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

Source: IEA World Energy Outlook 2007 (Reference Case); NorthBridge Analysis

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“…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

Who Gets the Ball with the Time Running Out?

Inputs
- Economist
- Lawyer
- Businessman
- Politician
- Engineer
- 2030
- 2025
- 2020

Technology

Climate Targets

???

THEN A MIRACLE HAPPENS

Economist
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

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

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

Transportation
- High speed mass transit foundation
- Congestion reduction

Aerospace
- High speed mass transit foundation
- Systems & fuel efficiency

Agricultural
- Alternative fuels
- Processing of liquids & gases

Chemical
- CO₂ capture
- Alternative fuels

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

Electrical
- Power generation & distribution
  - Smart grid; advanced meter interface
- Superconducting cable & other devices
- Renewable power integration
- Plug-in hybrid vehicles

Computer
- Systems efficiency

Environmental
- Wetlands protection & regeneration
- Miss. River delta; diversion
- Pollution reduction
- Recycling
NO COUNTRY FOR OLD MEN
ELLIS

“…What you got ain’t nothin’ new. This country is hard on people. Hard and crazy…”
“You can’t stop what’s comin. Ain’t all waitin’ on you… That’s vanity.”
“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

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.
"And then I woke up."
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