Water & Climate
The Earth is 70% water, but only 2.5% is freshwater. 

½ of 1% is available for use.

1.2 Billion w/o clean drinking water

3 Billion without sanitation

One car takes 105,000 Gallons

One Hamburger = 2,000 Gallons
OBJECTS IN MIRROR ARE CLOSER THAN THEY APPEAR
Projected Concentration After 50 More Years of Unrestricted Fossil Fuel Burning

Today's CO₂ Concentration

CO₂ Concentration

Temp. in F°
After 45 More Years of current energy use pattern

Today's CO₂ Concentration

CO₂ Concentration

Temp. in F°
Global Temperature 1861-2004

Source: Climatic Research Unit, University of East Anglia and Hadley Centre, The Met Office, UK
## Eventual Temperature Change (relative to pre-industrial)

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Impact/Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>0°C</td>
<td></td>
</tr>
<tr>
<td>1°C</td>
<td>Falling crop yields in many developing regions</td>
</tr>
<tr>
<td>2°C</td>
<td>Rising number of people at risk from hunger (25-60% increase in the 2080s in one study with weak carbon fertilisation), with half of the increase in Africa and West Asia.</td>
</tr>
<tr>
<td>3°C</td>
<td>Yields in many developed regions decline even if strong carbon fertilisation</td>
</tr>
<tr>
<td>4°C</td>
<td>Entire regions experience major declines in crop yields (e.g. up to one third in Africa)</td>
</tr>
<tr>
<td>5°C</td>
<td></td>
</tr>
</tbody>
</table>

### Food
- Severe impacts in marginal Senegal region
- Rising crop yields in high-latitude developed countries if strong carbon fertilisation

### Water
- Small mountain glaciers disappear worldwide – potential threat to water supplies in several areas
- Greater than 30% decrease in runoff in Mediterranean and Southern Africa
- Significant changes in water availability (one study projects more than a billion people suffer water shortages in the 2080s, many in Africa, while a similar number gain water)
- Sea level rise threatens major world cities, including London, Shanghai, New York, Tokyo and Hong Kong
- Coral reef ecosystems extensively and eventually irreversibly damaged
- Large fraction of ecosystems unable to maintain current form

### Ecosystems
- Many species face extinction (20-50% in one study)

### Extreme Weather Events
- Rising intensity of storms, forest fires, droughts, flooding and heat waves
- Small increases in hurricane intensity lead to a doubling of damage costs in the US

### Risk of rapid climate change and major irreversible impacts
- Risk of weakening of natural carbon absorption and possible increasing natural methane releases and weakening of the Atlantic THC
- Onset of irreversible melting of the Greenland ice sheet
- Increasing risk of abrupt, large-scale shifts in the climate system (e.g. collapse of the Atlantic THC and the West Antarctic Ice Sheet)
The question is: At what temperature will we stabilize?

750 ppm ~ 4.3 °C
550 ppm ~ 3 °C
450 ppm ~ 2 °C

There is the potential that the climate is likely, as projected by the IPCC, to take humankind where it has never been.
Greenland Total Melt Area – 2007 value exceeds last maximum by 10%
Portage Glacier

Alaska

1914

2004

Photos: NOAA Photo Collection and Gary Braasch – WorldViewOfGlobalWarming.org
USA: Louisiana

+ 1 meter

Weiss and Overpeck

Gulf of Mexico
USA: Louisiana

+ 6 meters

Gulf of Mexico

Weiss and Overpeck
United States

2004

New record for tornados:
1,717
Hurricane Tracks
When sea-surface temperatures were cooler (1985-1994)

83.6°F
83.3°F
83.0°F
28.3°C
82.7°F
82.4°F
82.1°F

Sea-surface Temperatures
1944-2004
Now that they’re warmer (1995-August 2005)

Storm paths

Lower intensity storm
Category 3-5 hurricane
Hurricane Katrina shown black
Changes in Tropical Cyclone Number, Duration, and Intensity in a Warming Environment

P. J. Webster,¹ G. J. Holland,² J. A. Curry,¹ H.-R. Chang¹

LETTERS

Increasing destructiveness of tropical cyclones over the past 30 years

Kerry Emanuel¹
Figure 6: Trend in Extreme Precipitation Frequency by Climate Division
Changes in climate are already causing harm

Major floods per decade, 1950-2000

There’s a consistent 50-year upward trend in every region except Oceania.
Brienz, Switzerland
August 26, 2005
Switzerland

August 23, 2005
Where we’re headed:
increased losses from weather-related events

Global costs of extreme weather events from 1950–2006 (adjusted for inflation)  
UNEP, 2008
**MOUNTING CALAMITIES**

Since the 1980s, the Earth’s temperature has risen at an increasing rate (below left), probably in response to rising concentrations of CO₂, the atmosphere’s main greenhouse gas. Signs of climate change are obvious in data assembled by Belgium’s Center for Research on the Epidemiology of Disasters: Calamities have become more frequent. (In part because the center only started in 1974, earlier data may not be as complete.)

Source: Swiss Re

*Global annual temperature relative to the 1981-90 mean.
Where we’re headed: more water scarcity

Where we’re headed: increased water tensions

“Fierce competition for fresh water may well become a source of conflict & wars in the future.” — Kofi Annan

Where we’re headed: droughts

Drought projections for IPCC’s A1B scenario

Percentage change in average duration of longest dry period, 30-year average for 2071-2100 compared to that for 1961-1990.
Moonscape: An Indian woman walks on the dried up Osman Sagar lake on the outskirts of the capital of the southern Indian state of Andhra Pradesh Hyderabad. The amount of the earth's surface afflicted by drought has more than doubled since the 1970s http://www.time.com/time/photoessays/2006/global_warming
Global destabilization . . .

- Rising sea levels
- Storms and storm severity
- Disease & famine
- Drought and heat waves
- Changing ecosystems
- Coral bleaching/marine ecosystems
- Political/economic disorder
- Death toll . . . Now at 150,000/yr (WHO)

Pieter Brueghel, The Triumph of Death, 1562
Global destabilization . . .

Already committed to substantial warming

Lag between cause and effect: decades-centuries

Too late to avoid trauma but not too late to prevent the worst

No easy way out

First global emergency

Pieter Brueghel, The Triumph of Death, 1562
“the perfect problem”

- complexity of the science
- time lag between cause and effect
- inertia: infrastructure, daily habits
- denial . . . “doesn’t effect me”
- partisan filters . . . right v. left
- motivation . . . collective action
- global v. national
Decarbonizing U.S. energy system

22 tons CO$_2$/person $\rightarrow$ ~2 tons CO$_2$ person

~90% reduction in greenhouse gases by 2050

Survival for equity
Climate leadership

What can the president do in the first 100 days?

300 proposals
law, regulation, federal purchasing, energy policy, transportation policy, urban policy, communication national security

80-90% CO₂ reduction by 2050

www.climateactionproject.com
You can’t handle the truth!

I have nothing to offer but blood, toil, tears, and sweat.
Winston Churchill, 1940
Beyond Left v. Right

Left

Past

Right

Past
U.S. Energy Policy:

$45 trillion to subsidize oil, gas, coal by tax breaks, waived royalties, outlays

$74 billion total (Koplow):

- 66% to fossil fuels
- 12.4% nuclear
- 7.6% to ethanol
- 7.5% to renewables
- 2% to conservation
Energy policy as the linchpin

energy/climate

Security

Economy

Health

Equity
FY 2008 FEDERAL SPENDING: MILITARY SECURITY VS. CLIMATE SECURITY

Smarter solutions . . .

don’t cause other problems

solve for pattern/security by design

technically feasible

competitive . . . CO\textsubscript{2}/$

can be deployed quickly

resilient, redundant, repairable
U.S. mid-range abatement curve – 2030

Potential Gigatons/year

Commercial buildings – Combined heat and power
Residential buildings – New shell improvements
Fuel economy packages – Cars
Residential electronics
Commercial electronics
Cellulosic biofuels
Onshore wind – Low penetration
Onshore wind – High penetration
Biomass power – Cofiring
Industry – CCS new builds on carbon-intensive processes
Coal power plants – CCS new builds with EOR
Carbon-to-gas shift – dispatch of existing plants
Coal power plants – CCS rebuilds
Car hybridization
Conservation tillage
Reforestation
Winter cover crops
Afforestation of cropland
Afforestation of pastureland
Coal-to-gas shift – dispatch of existing plants

Cost
Real 2005 dollars per ton CO₂e

Source: McKinsey analysis
What do we know?

Global Warming is real, has begun
A more vigorous hydrological cycle
Mid-continent areas—hotter, dryer
Rain events larger
Great lakes water levels will decline
Water quality will decline
Recreation, tourism, commerce decline
Great Lakes ecology will change due to higher temperatures, species loss
Potable water systems stressed
Dead zones likely to expand
What do we know?

Water policy = Energy policy

Cheaper to save than to increase supply
The right to life:
No generation has the right to alter Earth’s natural cycles or impair the stability, integrity, and beauty of nature—the consequences of which would be a form of intergenerational remote tyranny depriving all posterity of life, liberty, property.
“The Great Work”

Stabilize/reduce all heat trapping gases

Rapid transition to efficiency and renewables

Global Bargain: survival for equity (C/person)

Precaution, humility, fairness—generations/species

“Prosperous way down,” The Odums

Politics as Trusteeship
The Third Thing

Water is two parts hydrogen, one part Oxygen

But there is a third thing that makes it water and no one knows what it is.

D. H. Lawrence