Energy; Climate; Action: What Next in a World of Denial?

Chris Rapley
Director Science Museum
Prof. Climate Science - UCL Earth Sciences
Visiting Prof. Imperial College
19th May 2010
Earth System

- Most complex object in the Universe
- Challenge to Study & Understand
- No User’s Manual
- Finite - No Spares!
- “Ecosystem Services” Essential for Life
- “Unhealthy State” - Driven by Humans
IGBP CLIMATE-CHANGE INDEX

Cumulative annual change
(Normalised annually between −100 and +100)

• Global Average Temperature
• Atmospheric Carbon Dioxide
• Sea Level Rise
• Arctic Summer Sea Ice Cover

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ORGANIC
FOSSIL
3,500 people for 1h
Energy Slaves

Recreation:
16 men. Includes energy for leisure activities plus production of goods and services.

Heating:
12.2 men. Self explanatory

Food:
11.4 men. Energy for cooking, eating and drinking, including food miles and production of raw materials

Household:
11.2 men. This includes non-heating energy consumed in the home by appliances, furnishings and from the construction of the building itself

Hygiene:
11 men. Includes energy for the NHS and from individuals bathing and washing

Clothing:
8.2 men. Energy for producing, transporting and cleaning clothes and shoes.
We are all carbon slaves!!

Impact of 8-day strike by petrol tanker drivers in Sep 2000 was to bring UK to a halt
Carbon Reservoirs & Transfers

500 GtC

Energy - “Fleeting By-Product”
Transforming the Atmosphere

$\text{CO}_2$

2100

Now

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Greenhouse Effect

Mercury
179°C

Venus
420°C

Earth
15°C

Mars
-50°C

30°C

atmosphere

earth

Moon
-15°C

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Paleocene-Eocene Thermal Maximum (PETM)

1500 GtC
6°C ΔT

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A Pattern of Behaviour
Surface Warming

Stratospheric Cooling

Ice Sheet Mass Loss

Changing Seasons & Ecosystem Shifts

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Ranking of Years by Temperature
Arctic Sea Ice
Summer Minimum Extent

ARCTIC SEPTEMBER SEA ICE EXTENT
Million square Kilometres

Year

Observations  Mean of models  Standard deviation of models

SOURCE: NSIDC
Current Status
90% of Heat Imbalance
Mercator_Ocean_PSY3V2 1/4 deg
Global

Temperature (degC)

Depth (m): 1000
Time: 12–may–2010 (analysis)

Max
29.4
Min
-1.8
Average
4.2
Attribution
Sea Level Rise
“Global Thermometer”

<2003 - thermal expansion and ice melt
>2003 - ice melt - polar ice sheets / glaciers

NOAA/Laboratory for Satellite Altimetry
global ocean
mean sea level anomaly
Annual signals removed

trend = 3.0 ± 0.4 mm/year
mysteries still to solve
IPCC Fourth Assessment Report
Climate Change 2007

Climate Warming Unequivocal

Climate forcing primarily Human

Serious - Water, Food Supply, Ecosystems, Global Stability
Scientists Submit Letter Defending Conclusion that Climate Change Is Accelerated By Human Activity

In a letter from 255 members of the National Academy of Scientists, published in Science Magazine, they claim that climate change is a fact, as is the contribution of human activity to global warming. In a sharply worded letter decrying "McCarthy-like threats" the letter states in part:

"But there is nothing remotely identified in the recent events that changes the fundamental conclusions about climate change:

(i) The planet is warming due to increased concentrations of heat-trapping gases in our atmosphere. A snowy winter in Washington does not alter this fact.

(ii) Most of the increase in the concentration of these gases over the last century is due to human activities, especially the burning of fossil fuels and deforestation.

(iii) Natural causes always play a role in changing Earth's climate, but are now being overwhelmed by human-induced changes.

(iv) Warming the planet will cause many other climatic patterns to change at speeds unprecedented in modern times, including increasing rates of sea-level rise and alterations in the hydrologic cycle. Rising concentrations of carbon dioxide are making the oceans more acidic.

(v) The combination of these complex climate changes threatens coastal communities and cities, our food and water supplies, marine and freshwater ecosystems, forests, high mountain environments, and far more."
Global temperature change (relative to pre-industrial)

<table>
<thead>
<tr>
<th>0°C</th>
<th>1°C</th>
<th>2°C</th>
<th>3°C</th>
<th>4°C</th>
<th>5°C</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Food</strong></td>
<td></td>
<td></td>
<td>Falling crop yields in many areas, particularly developing regions</td>
<td></td>
<td>Falling yields in many developed regions</td>
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<td></td>
<td></td>
<td>Possible rising yields in some high latitude regions</td>
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<tr>
<td><strong>Water</strong></td>
<td>Small glaciers disappear – water supplies threatened in several areas</td>
<td>Significant decreases in water availability in many areas, including Mediterranean and Southern Africa</td>
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<td>Sea level rise threatens major cities</td>
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<tr>
<td><strong>Ecosystems</strong></td>
<td>Extensive Damage to Coral Reefs</td>
<td>Rising number of species face extinction</td>
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<tr>
<td><strong>Extreme Weather</strong></td>
<td>Rising intensity of storms, forest fires, droughts, flooding and heat waves</td>
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<tr>
<td><strong>Risk of Abrupt and Major Irreversible Changes</strong></td>
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<td></td>
<td>Increasing risk of dangerous feedbacks and abrupt, large-scale shifts in the climate system</td>
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</tbody>
</table>
5000y ago
• Climate has always changed
• Greenhouse Effect is 30°C
• Natural carbon balance disturbed by humans
• Increasing GHGs will increase warming
• Warming will alter atmospheric circulation and climates
• Pattern of evidence reveals human component of change
• Modern world assumes the climate we inherited
Safe Climate Change?

450ppm CO$_2$ equivalent gives a 50:50 chance of 2°C

1000GtC limit
Decarbonising Humankind
Decarbonising Humankind

$\text{Improve Global Equity}$
$\text{Maintain Social Stability - Flourish}$
$\text{Transition to Low-C World}$
A global revolution is needed in the ways energy is supplied and used
Partnership Required

Technology
Finance
Governance
Permissions

The picture illustrates the partnerships required across people use, and the infra-structure available, including government, business and people.
Human Ingenuity Unbounded?
Cost-Benefit Analyses

Cost of Inaction Exceeds the Cost of Action

McKinsey II
$20-65Tn to 2050
0.4-1.5%GDP
Leadership and Governance
Leadership and Governance
Governance is critical

- Scramble - Events Outpace Actions
- Blueprints - Actions Outpace Events
“Blueprints” stabilises at 630 ppm CO$_2$e

“Scramble” passes 1000 ppm CO$_2$e in 2100

Source: MIT

Friday, 21 May 2010
What people believe matters
Climate scepticism 'on the rise', BBC poll shows

The number of British people who are sceptical about climate change is rising, a poll for BBC News suggests.

The Populus poll of 1,001 adults found 25% did not think global warming was happening, an increase of 10% since a similar poll was conducted in November.

The percentage of respondents who said climate change was a reality had fallen from 83% in November to 75% this month.

And only 26% of those asked believed climate change was happening and "now established as largely man-made".

The findings are based on interviews carried out on 3-4 February.

In November 2009, a similar poll by Populus - commissioned by the Times newspaper - showed that 41% agreed that climate change...
FRESH doubts were cast over controversial global warming theories yesterday after a major climate change argument was discredited.

The International Panel on Climate Change admitted its key claim that Himalayan glaciers would melt by 2100 was based on an analysis of a 1999 magazine article.

James Delingpole
James Delingpole is a writer, journalist and broadcaster who is right about everything. He is the author of numerous fantastically entertaining books including Welcome To Obamaland: I've Seen Your Future And It Doesn't Work, How To Be Right, and the Coward series of WWII adventure novels. His website is www.jamesdelingpole.com.

Climategate: the final nail in the coffin of 'Anthropogenic Global Warming'? 
Snowfall leads to traffic chaos

Traffic was severely disrupted and all buses have been suspended in Reading as heavy snow swept across Berkshire for the second time in four days.

All Reading Buses services were suspended and traffic on the M4 motorway and many other roads were "at a standstill".

The Met Office issued a severe weather warning and more snow is expected.

It said accumulations of up to 10cm (4in) of snow were expected in places, especially on higher ground.

Reading Buses said: "All roads in the area are at a standstill. We apologise for any inconvenience caused to customers."

'Extreme caution'

Traffic on the M4 motorway was "very slow traffic with severe delays both ways" due to the snow.
January 2010 warmest on record. Yes really!

Paul Hudson | 22:11 UK time, Thursday, 4 February 2010

It may come as a surprise to many of you, shivering through the coldest British winter for decades, but data released this evening shows that global temperatures, as measured by satellites, rocketed in January to a new record.

The global-average lower tropospheric temperature anomaly rose to +0.72 deg. C in January 2010 on the UAH satellite measure. This is the warmest January in the 32-year satellite-based data record.

The global-average warmth is approaching the warmth reached during the 1997-98 El Nino, which peaked in February of 1998. 1998 on most measures was the hottest year on record.

This measure is important to sceptics who question the validity of land based measurements, which, they say, may be compromised to some extent by the urban heat island effect. The UAH satellite data has shown some warming since it began measurements in the late 1970's - but not as much as land based thermometers show. These satellite measurements are not calibrated to surface thermometer data in any way.

Of interest was the Northern hemisphere which rose sharply on this measure from December's levels - and gives a graphic illustration that despite many populated areas of
Temperature Anomalies January 2010
(with respect to a 1971-2000 base period)
National Climatic Data Center/NESDIS/NOAA

Degrees Celsius
### Table 1: Impact of allegations against climate science

<table>
<thead>
<tr>
<th>CRU/UEA emails</th>
<th>...on the science</th>
<th>...on public perception</th>
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<tbody>
<tr>
<td>Data manipulation</td>
<td>![Symbol]</td>
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<tr>
<td>Withholding data</td>
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<td>Scientific fraud</td>
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<tr>
<td>Muzzling of opponents</td>
<td>![Symbol]</td>
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<tr>
<td>Hockey stick controversy</td>
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<tr>
<td>Himalayan glaciers</td>
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<td>Climate risk in the Netherlands</td>
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<tr>
<td>Natural disasters</td>
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</tr>
<tr>
<td>Amazon rainforest loss</td>
<td>![Symbol]</td>
<td>![Symbol]</td>
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<tr>
<td>Snow</td>
<td>![Symbol]</td>
<td>![Symbol]</td>
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<tr>
<td>Aggregate</td>
<td>![Symbol]</td>
<td>![Symbol]</td>
</tr>
</tbody>
</table>

*Source: Bloomberg New Energy Finance*

- **No impact**
- **Minimal impact**
- **Medium impact**
- **Major impact**
- **Significant impact**
Evidence is not the issue
People react to information based on their deeply held beliefs

They endorse the position shared by those with whom they identify and whose esteem they seek
Climate Science is Uncertain
Population Must Be Controlled
Nuclear Power is Essential
Don’t let UN run the Planet!
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• **Denial**
  - closed-minded
  - position staked out in advance
  - confirmation bias
  - driven by ideology or religious belief

• **Scepticism**
  - open-minded
  - examine claims
  - consider evidence
  - follow the facts
Denial
- closed-minded
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Scepticism
- open-minded
- examine claims
- consider evidence
- follow the facts
• Tribalism
• Rules of Engagement
• “Wild-West” of the Web
• Sowers of Doubt
• Positive vs Normative issues
• Probability and Risk
• Who to believe?
Mode of Discussion

Debate/Advocacy

- assuming there is one right answer
- combative
- about winning
- listening for flaws
- defending assumptions
- pursuing your outcome

Dialogue

- assuming others have pieces of the answer
- collaborative
- about finding common ground
- listening to understand
- exploring assumptions
- discovering new possibilities
Uniquely Vexed Issue

- Evidence Complex & Technical
- Disconnect
- Inertias
- Vested Interests
- Inadequate Instruments and Institutions
- Challenges foundations of modern world

- Trust
Science Needs to Address

- Observations - What is happening?
- Understanding - How and Why?
- Prediction - What will happen Where/When?

Analysis - What could we do?
Ethics - What should we do?
Policy/Politics - What can/will we do?

to underpin
Also ...

- Raise Interest
- Deepen Understanding
- Maintain vigilance over accuracy
- Build Trust in Science and its Process
Opinion Formers

Really

We need to take this seriously
If the climate system were a bank, governments would have rescued it by now

Kofi Annan following Hugo Chavez

Friday, 21 May 2010