Climate Change and Fossil Fuel Depletion

Prof. Jean-Pascal van Ypersele

IPCC Vice-Chair/Vice-président du GIEC, (Université catholique de Louvain, Louvain-la-Neuve, Belgium),

www.ipcc.ch & www.climate.be
vanyp@climate.be

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“... The sum of all likely fossil-fuel demands in the early decades of the [21st] century might ... greatly increase the emission of carbon dioxide into the atmosphere and by doing so bring up average surface temperature uncomfortably close to that rise of 2°C which might set in motion the long-term warming up of the planet.”


The Care and Maintenance of a Small Planet

ONLY ONE EARTH

An Unofficial Report Commissioned by the Secretary-General of the United Nations Conference on the Human Environment. Prepared with the assistance of a 152-member committee of corresponding consultants in 58 countries.

by Barbara Ward and René Dubos
B. Ward & R. Dubos, 
*Only one Earth: the Care and Maintenance of a Small Planet*, 
New York, London: 
W W Norton & Company, (1972) 1983
And this one, about fossil fuel?

“We cannot long maintain our present rate of increase of consumption. (...) The check to our progress must become perceptible within a century from the present time; that the cost of fuel must rise (...) and the conclusion is inevitable, that our present happy progressive condition is a thing of limited duration.”   

William Stanley JEVONS (1866) « An inquiry concerning the progress of the nation and the probable exhaustion of our coal-mines » (see Google books).
Outline

- Climate Change
  - Climate *is* changing
  - IPCC
  - WGI, II, and III AR4

(Fossil Fuel Depletion: not me!)

A few Links between CC & FFD
Warming is Unequivocal

- Rising atmospheric temperature
- Rising sea level
- Reductions in NH snow cover
Warming has not « stopped »: Global (land & ocean) mean surface temperature change from NASA GISS until 2010

Source: NASA GISS
Extension of the Arctic ice cap

September 1979

September 2005

September 2007

The pink line indicates the average ice cap extension since 1979
CO₂ concentration measured at Mauna Loa (3400 m)

Atmospheric CO₂ at Mauna Loa Observatory

1974-2008 NOAA/ESRL

Source: Dr. Pieter Tans, NOAA/ESRL (www.esrl.noaa.gov/gmd/ccgg/trends/)
Jean-Pascal van Ypersele
(vanyperele@astr.ucl.ac.be)
Carbon cycle

Units: GtC (billions tons of carbon) or GtC/year

Atmosphere
pre-ind : 597

partie II
Physical, Chemical, and Biological processes
70.5

partie III
Ocean
38000

partie IV
Combustibles fossiles (charbon, pétrole, gaz naturel)
3700

photosynthesis
120

respiration
119.5

matière organique en décomposition
2300

décomposition
rivieres
1

vanyp@climate.be
Carbon cycle

Atmosphere

pre-ind: 597 + 3.2/an

partie I

photosynthesis

120

2.6 \text{sinks}

partie II

Physical, Chemical, and Biological processes

119.5

2.2

1.6 \text{déforestation} (\& land use changes)

partition III

partie IV

Ocean

38000 +120

Fossil fuels

6.4

3700 -244

Units: GtC (billions tons of carbon) or GtC/year

matière organique en décomposition

2300 -40

rivieres

1

décomposition

vanyp@climate.be
Number of papers published on climate change
Why the IPCC?
Established by WMO and UNEP in 1988

to provide policy-makers with an objective source of information about

• causes of climate change,
• potential environmental and socio-economic impacts,
• possible response options.
What is the IPCC (GIEC in French)?

- IPCC: Intergovernmental Panel on Climate Change
- Created by World Meteorological Organisation (WMO) & United Nations Environment Programme (UNEP) in 1988
- Mandate: assess the science of climate change, impacts and adaptation, mitigation options
- Nobel Peace prize (2007)
- Web: http://www.ipcc.ch
The IPCC Fourth Assessment Report (2007)

+130 countries

around 450 lead authors

around 800 contributing authors

+2500 scientific expert reviewers

+18000 peer-reviewed publications cited

+90000 comments from experts and Governments
Next IPCC Report
(published 9 May 2011)

Special Report on Renewable Energy Sources and Climate Change Mitigation
IPCC Working Group I: climatology
Key points from the WG1 IPCC AR4 Report

- Warming of the climate system is unequivocal
- Very high confidence that net effect of human activities since 1750 = warming
- Last 50 years likely to be highest temperature in at least last 1300 yrs
- Most of this warming is very likely due to increase in human greenhouse gases
- Without emission reduction policies, global temperature could increase by 1.1 to 6.4°C, or even higher in 2100 compared to 1990
- Sea level could increase by 18 to 59 cm, or more
- Frequency/intensity of several extreme phenomena due to increase (ex: heat waves, droughts, floods, …)
Are observed changes consistent with expected responses to natural forcings?

IPCC (2007):
“Warming is unequivocal, and most of the warming of the past 50 years is very likely (90%) due to increases in greenhouse gases.”
Climate projections without mitigation


NB: écart par rapport à la moyenne 1980-1999

Jean-Pascal van Ypersele
(vanypiercele@astr.ucl.ac.be)
More heavy precipitation and more droughts....
More heavy precipitation and more droughts....
Ice sheet melting

- Melting of the Greenland ice sheet
  - Total melting would cause 7 m SLR contribution
- Melting of the West Antarctic Ice Sheet
  - Total melting would cause 5 m SLR contribution
- Warming of 1 – 4°C over present-day temperatures would lead to partial melting over centuries to millennia
Significant inertia exists in the climate system.

- CO₂ emissions peak: 0 to 80 years
- CO₂ stabilization: 50 to 300 years
- Sea-level rise due to ice melt: some millennia
- Sea-level rise due to thermal expansion: century to millennia
- Temperature stabilization: a few centuries

Source: IPCC (2001)
IPCC Working Group II: Impacts, Vulnerability, and Adaptation
TP Figure 3.4: Ensemble mean change of annual runoff, in percent, between present (1980-1999) and 2090-2099 for the SRES A1B emissions scenario (based on Milly et al., 2005).
20% - 30% of plants and animals species likely at “increased risk of extinction”

if ΔT 1.5°C - 2.5°C (above 1990 temperature)
Figure TS.7. Sensitivity of cereal yield to climate change
Effects on Nile delta: 10 M people above 1m
With 8 metre sea-level rise: 3700 km$^2$ below sea-level in Belgium
(very possible in year 3000)
(NB: flooded area depends on protection)

Source: N. Dendoncker (Dépt de Géographie, UCL), J.P. van Ypersele et P. Marbaix (Dépt de Physique, UCL) (www.climate.be/impact)
Daily mortality in Paris (summer 2003) (IPCC AR4 Ch 8)
I Risks to unique and threatened systems
II Risks from extreme climate events
III Distribution of Impacts
IV Aggregate Impacts
V Risks from large-scale discontinuities

Source: IPCC TAR WG2 (2001)
What does IPCC tell us on mitigation?

**WG3: Mitigation**
The lower the stabilisation level the earlier global emissions have to go down

Equilibrium global mean temperature increase over preindustrial (°C)

GHG concentration stabilization level (ppmv CO2-eq)

Multigas and CO2 only studies combined
All sectors and regions have the potential to contribute by 2030

Note: estimates do not include non-technical options, such as lifestyle changes.
A few Links between Climate Change and Fossil Fuel Depletion

…” as seen by a climate scientist
There is too much fossil to heat the climate above 2°C
Adaptation will be necessary to address unavoidable impacts (valid for both CC & FFD)
What is good for climate is good to delay peak oil & fossil fuel depletion

We need to anticipate, look beyond borders (of any kind), think in an open & integrated manner, with interdisciplinarity, in dialogue with stakeholders, conscious of the effects of our decisions on inter- and intra-generational equity
Role of Technology, following IPCC AR4
Changes in lifestyle and behaviour patterns can contribute to climate change mitigation

- Changes in occupant behaviour, cultural patterns and consumer choice in buildings.
- Reduction of car usage and efficient driving style, in relation to urban planning and availability of public transport
- Staff training, reward systems, regular feedback and documentation of existing practices in industrial organizations
Relationship between urban sprawl and energy use per capita in transport (t oil-equivalent/year)
The pricing of carbon is effective:

Negative correlation between fuel price and consumption

Source: Factor Four
**Examples of side-effects of climate mitigation**

<table>
<thead>
<tr>
<th>OPTIONS</th>
<th>SYNERGIES</th>
<th>TRADEOFFS</th>
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| **Energy:** efficiency, renewables, fuel-switching | • air quality  
• supply security  
• employment  
• costs (efficiency) | • particulate emissions (diesel)  
• biodiversity (biofuels)  
• costs (renewables) |
| **waste:** landfill gas capture, incineration | • health & safety  
• employment  
• energy advantages | • ground water pollution  
• costs |
A last argument to save fossil fuels:

Keep them for when humanity will need them to counter the next glaciation (due to astronomical factors), in 30-50 thousand years from now…
A quote from a geologist

« This century was that of science; but its last years can be called the era of the wasting; and the thirst to enjoy, without delay and moderation, too often brought the dilapidation of the resources whose progress of our knowledge had brought the discovery; all the more guilty dilapidation, that one knew better and better to which point this provision is limited, and which it is forbidden to hope for its prompt reconstitution »…(Ce siècle a été celui de la science; mais ses dernières années peuvent s’appeler l’ère du gaspillage; et la soif de jouir, sans retard et sans mesure, a trop souvent amené la dilapidation des ressources dont le progrès de nos connaissances avait amené la découverte; dilapidation d’autant plus coupable, qu’on savait de mieux en mieux à quel point cette provision est limitée, et qu’il est interdit d’en espérer la prompte reconstitution.) A. de Lapparent (1899), quoted by Juhel (2011) “Histoire du pétrole”
« Also it would be necessary to have (...) a severe judgment against intelligences which, having known to see so many things, so completely failed to exert a salutary direction on the wills. »

A. de Lapparent (1899), quoted by Juhel (2011) “Histoire du pétrole”
Useful links:

- www.ipcc.ch : IPCC
- www.unfccc.int : Climate Convention
- www.skepticalscience.com: answers to « skeptics »
- www.climate.be/vanyp : my slides and other documents